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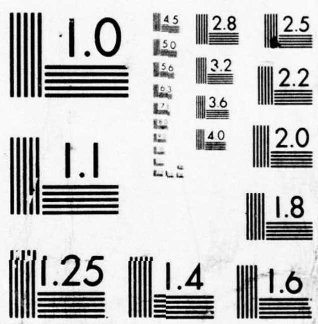

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Manufacturing Methods & Technology Technical Report

ECOM-77-0526-1

MANUFACTURING METHODS AND TECHNOLOGY FOR TAPE CHIP CARRIER

William R. Rodrigues de Miranda
Honeywell Inc.
St. Petersburg, Florida 33733

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Quarterly Report for Period Ending 30 September 1977

(Approved for Public Release – Distribution Unlimited)

PREPARED FOR

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US ARMY ELECTRONICS COMMAND FORT MONMOUTH, NEW JERSEY 07703

CONTRACT NO. DAAB07-77-C-0526
HONEYWELL INC.
St. Petersburg, Florida 33733

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Prepared for U.S. Army Electronics Command
Ft. Monmouth, NJ

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QUARTERLY TECHNICAL REPORT FOR PERIOD ENDING 30 SEPTEMBER 1977
MANUFACTURING METHODS AND TECHNOLOGY ENGINEERING FOR
TAPE CHIP CARRIER

CDRL C-002

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INTRODUCTION

The purpose of this program is to demonstrate the concept of an automated assembly line for hybrid microcircuits, through the establishment of techniques for tape carrier mounting of semiconductor chips, burn-in and testing of these chips on tape and their placement into representative hybrid circuits. The Tape Chip Carrier (TCC) system permits mounting of semiconductor chips on reels of sprocketed film. The system is an established means of automating the interconnection of individually packaged semiconductor chip devices. It has been adapted to the fabrication of hybrid microcircuits used in the manufacture of certain commercial computers. Its overall adaptation to the hybrid microcircuit industry is expected to be greatly enhanced by this program. The automated assembly line will make use of an automatic feed mechanism at each process step, and magazines to transport substrates and partially assembled circuits between process points.

This is the first quarterly report on the MM&T program. At this important milestone, Honeywell is pleased to report excellent progress in all areas of activity.

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Section 1

EQUIPMENT

This task covers the evaluation of existing, in-house equipment for possible use for the MM&T tasks to be performed, and the review of requirements and preparation of specification for equipment to be purchased. Each of the pieces of major equipment required for the program are listed on the PERT chart submitted as CDRL - A001 in August 1977, and will be further discussed below.

A. THICK FILM EQUIPMENT

After review of a number of different candidates the Weltek Model 44 printhead was selected as the most suitable for use on the automated line. This decision was based on: 1) the ease of adaptability to the Honeywell designed feed system (See Section III), 2) the good quality and simplicity of this printer and 3) the fact that this facility has an automatic printing and drying system on order from Weltek for another program, and which uses the same printhead. This printer will be the first of the manufacturing equipment on which the Honeywell automatic feed system will be interfaced and tried out (see Figure 1-1).

B. REEL-TO-REEL PLATER

It has been decided not to perform reel to reel gold plating of lead frame tape in house as several vendors are available who have both equipment and experience to do this job. One of the vendors, Reliable Electronic Finishing Co. of Canton, MA has been visited. All vendors have submitted quotes. Vendor selection will be made during the next reporting period.

C. AUTOMATIC WIRE BONDER

One K&S Model 1413 Automatic Wire Bonder is currently being used in this facility's regular production line. Valuable production experience is being gained from this equipment. A second bonder, to be dedicated to the ECOM line, will be specified in December and ordered in January 1978. This bonder will have the automatic pattern recognition feature.

D. OUTER LEAD BONDER - FRAMER

A meeting was held at Honeywell with personnel of the Jade Corporation in order to initiate detail definition of the configurations of the

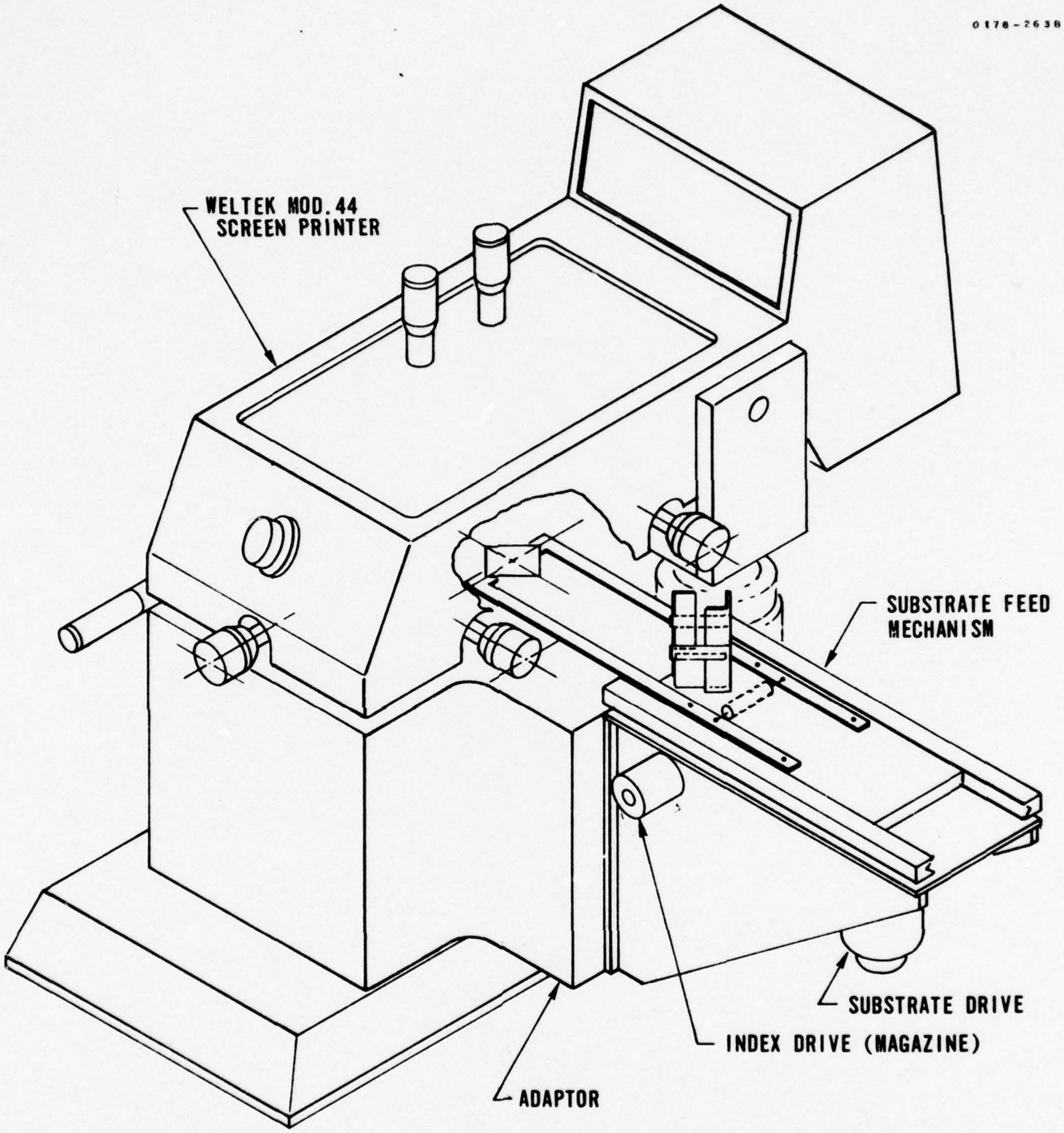

FIGURE 1-1. WELTEK MODEL 44 SCREEN PRINTER
WITH HONEYWELL SUBSTRATE FEED MECHANISM

Outer Lead Bonding and Tape Testing Equipment. A tentative decision was made to provide tape coding capability by adding a strip of magnetic tape to the 35 mm carrier frame. Also it was decided to review the possibility of having the carrier frame fit a smaller size tape (e.g., 19 mm) as well. The Jade Massbond 4810 manual integrated Outer Lead Bonder was delivered and installed at Honeywell. Operation of this equipment will play a key role in establishing the detail requirements for the automatic system.

Jade will start the initial design phase of the equipment. Final specifications will be written during December and January. Equipment will be ordered in the January-February 1978 time frame.

E. OUTER LEAD BONDER - TESTER/CODER

See Item D, Outer Lead Bonder - Framer

F. OUTER LEAD BONDING - COMPOSER

See Item D, Outer Lead Bonder - Framer

G. OUTER LEAD BONDER - ASSEMBLER

See Item D, Outer Lead Bonder - Framer

H. DIE PLACEMENT AND EPOXY DISPENSER

A visit was made to K&S in September 1977 to obtain information on design concepts by K&S. A machine (Model 621) for this purpose was on the drawing board at that time. A visit of K&S to Honeywell has been scheduled for late November, in order to further define the equipment and to prepare specifications. The equipment will be ordered in January 1978.

I. BURN-IN EQUIPMENT

Initial design concepts of the burn-in equipment have been completed. The current approach will make use of the tape deposited into 35 mm carriers in individual frames. A tray has been designed which will provide electrical contact to about 100 carriers. A temperature control system will be designed which can accept up to 10 trays. Final equipment specifications will be completed in February 1978 as currently scheduled on the PERT chart. Equipment will be manufactured in-house.

J. TAPE INSPECTION EQUIPMENT

After a careful review it was decided that no special tape inspection equipment, other than that already in-house, may not be required. This equipment consists of manual spooler/despooler with a Bausch & Lomb Model Stereozoom 7 microscope set-up. Further review of this equipment, now scheduled for December, will determine if further modifications are required. If such is the case, the modifications will be made in-house.

K. INNER LEAD BONDER

The Inner Lead Bonder will be much like the standard equipment available at Jade. The few minor special requirements will be specified during December and January. The bonder will be ordered in March 1978 as shown in the PERT chart.

L. LASER EQUIPMENT

No activity was scheduled during this reporting period for modifications of the automatic laser equipment to mark reject chips. Specifications activity is scheduled for February 1978.

M. CAPACITOR PICK AND PLACE

Extensive work has been accomplished on the Browne Model CP-10 capacitor placement equipment now operational in the facility. Additional evaluation will continue during the month of December in preparation for modifications to adapt the automatic feed system.

N. WAFER INSPECTION EQUIPMENT

The requirements for wafer inspection equipment have undergone an initial review. There is a possibility that no special modifications to existing equipment (Nikon Model 71772) needs to be made. Review will continue and a decision will be made at the end of December 1977.

O. AUTOMATIC TEST EQUIPMENT

Existing automatic test equipment (Fairchild 5000, Hewlett-Packard 3042A and Macrodata 150) will be used to test the sample hybrids. Programs are now being written for the first lot of engineering samples. Modifications will be made as necessary during the next reporting period.

Section 2

FACILITY

Facility plans are only in the preliminary stage with the determination of the space requirements for the new equipment items. The process flow has been largely determined and a preliminary diagram is shown on Figure 2-1. More definite plans will be prepared during the next reporting period.

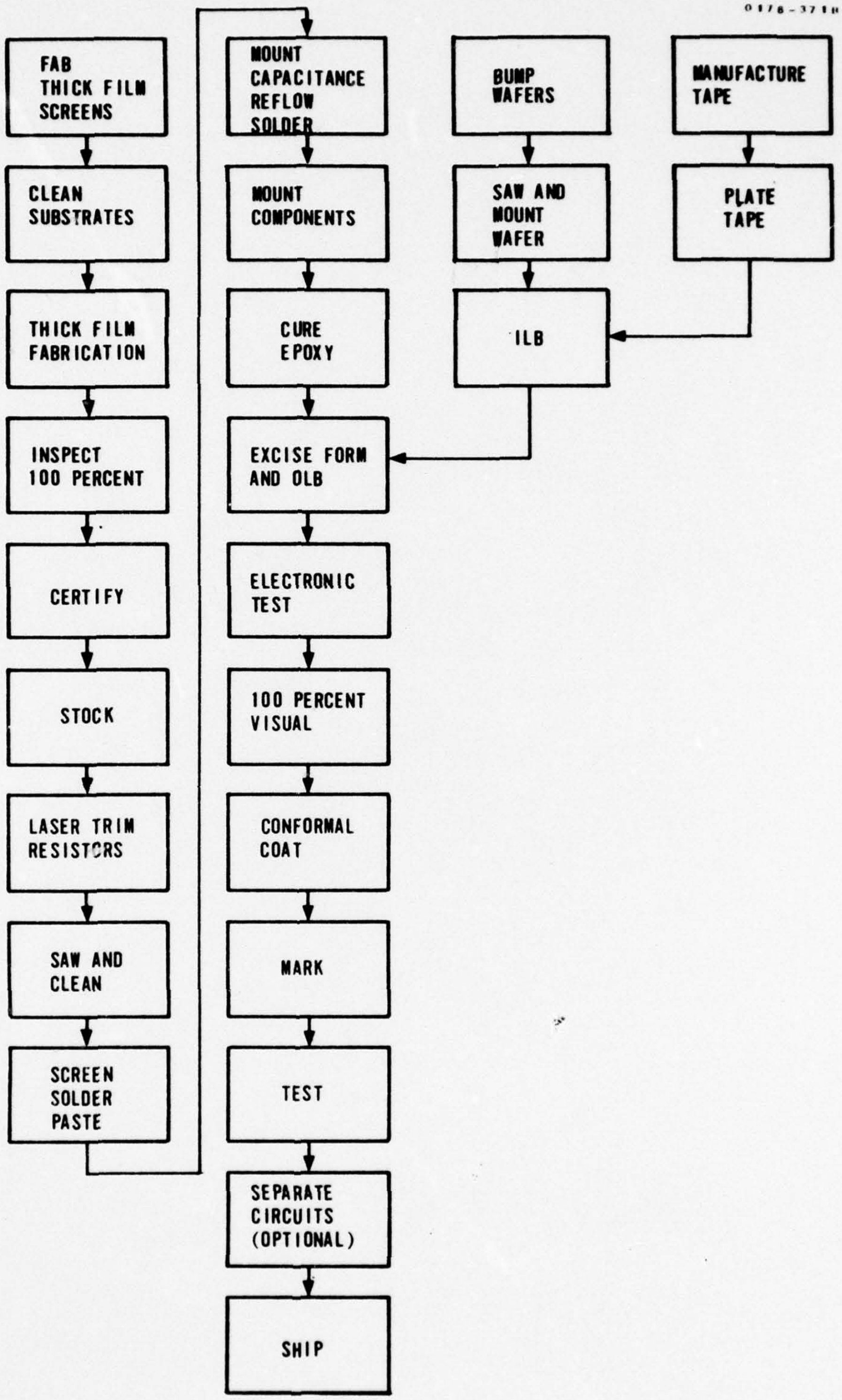

FIGURE 2-1. PRELIMINARY PROCESS FLOW CHART

Section 3

MATERIAL HANDLING

A key objective of the MM&T program is to develop automatic handling techniques and equipment for the hybrid substrates.

The substrate size has been standardized a 2" square by .025" - .040" thick. A typical substrate is processed thru (9) different work stations;

1. Thick Film Printer
2. Thick Film Dryer
3. Thick Film Furnance
4. Laser Trim (Resistors)
5. Pick and Place (capacitors)
6. Solder Reflow
7. Epoxy Dispense and Die Place
8. Outer Lead Bond
9. Auto Wire Bond.

The thick film printing, drying and firing operations are repeated an average of 10 times on each substrate, thus the typical substrate is handled approximatley 40 times.

The substrates will be handled manually only at the initial loading into a 50 slot magazine. (See Figure 3-1) Thereafter they will be automatically fed from the magazine to the work station, processed, and fed back into the magazine. Magazines will be transported manually.

To meet substrate quality, cost and production rate requirements the following groundrules were established for the handling equipment:

1. The same magazines will be used for all handling and for "dry box" storage.
2. The magazines will keep individual substrates physically separated.
3. The automatic feed mechanisms will be basically similar for all work stations.

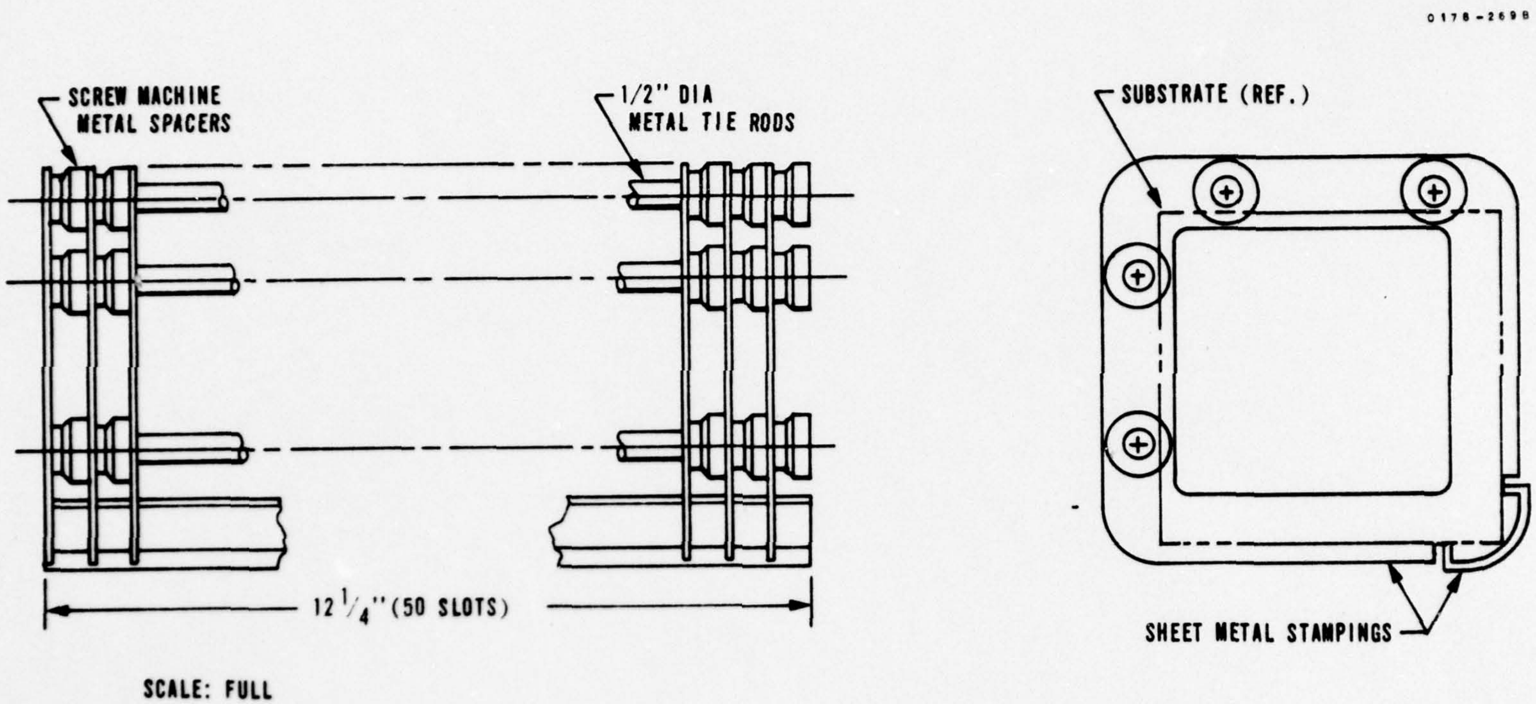

FIGURE 3-1. SUBSTRATE MAGAZINE

4. The automatic feed cycle - moving the substrate from magazine to work station, back into the magazine & indexing to the next substrate, will be accomplished in 1.5 secs. maximum.

5. In all operations, location will be against the same three points on the same two edges of the substrate.

6. Substrate positioning accuracy on the various work stations will be repeatable to within .0015".

7. Automatic feeding will be continuous - there will be no "break" between magazines.

It was decided to design & build the automatic handling equipment in-house for the following reasons:

1. Very little of this type equipment is commercially available. What is available is the general purpose type that would require considerable modification to meet our requirements. None of it is shelf hardware. It would have to be built to order.

2. The automatic handling equipment must be adapted to (9) different work stations, some of which are still in the development stage. In-house design and build of the handling equipment greatly simplifies the coordination and scheduling problems.

3. We have the in-house design and build capabilities.

We are developing, in parallel, two basically different types of automatic handling equipment; A mechanical handler and an air handler.

The mechanical handler employs feed fingers driven by a programmed step motor to transport and position substrates. It differs from conventional feed mechanisms in three basic respects: (See Figure 3-2)

1. The fingers grip the substrate by opposing corners. This eliminates interference between fingers and work table locating pins and allows use of the fixed locating pins. Inherently the most accurate approach. As the feed fingers move past the substrate seating point, they ride up the edges of the substrate and hold it under spring tension against the locating pins. This eliminates the conventional additional "snugger" mechanism.

2. The feed fingers are driven thru "V" grooves spring loaded against drive pins. When return travel of the fingers is halted by the stop pins, continued travel of the drive pins opens the fingers, releasing the substrate and allowing clearance for the magazine to index. Stop pins (not shown) are added at the other end of the travel to open the fingers at the work table when the table must be moved during substrate processing.

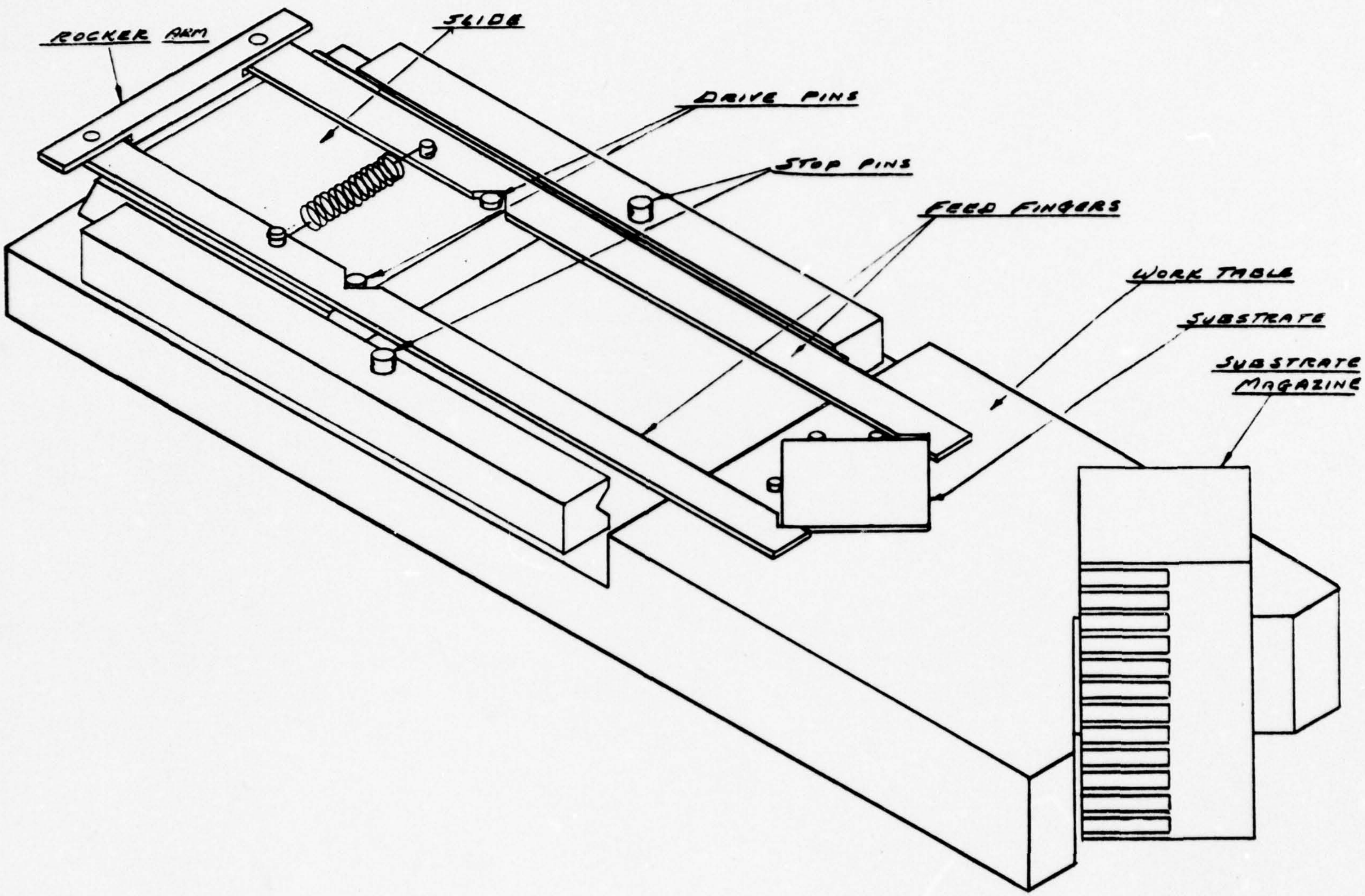

FIGURE 3-2. MECHANICAL AUTOMATIC SUBSTRATE HANDLER

3. The rear ends of the feed fingers are pivoted in a rocker arm. This, combined with the "V" groove drive, allows the substrate a limited "float" both in rotation and at right angles to the direction of travel, thus eliminating locating errors due to substrate dimensional variations.

We have a high confidence level in the mechanical approach since it uses proven techniques. The first mechanical handler will be adapted to the Weltek thick screen machine. (See Figure 3-3).

The alternative air handler (See Figure 3-4) employs directed air jets to transport and position substrates. It offers significant advantages in cost, size, and reliability over the mechanical handler. Short stroke feed fingers move the substrate from the magazine onto the air slide. A series of air jets slanted at 45° to the direction of travel and directed against the bottom of the substrate move it to the work table and against the (3) locating points. The substrate is held in position during processing by vacuum.

After processing it is moved back to the magazine by a second series of air jets slanted in the opposite direction. Inertia carries it into the magazines.

A feasibility model has been built which demonstrates that air jets will transport and position substrates with the required speed, accuracy and safety. However the air handler uses several unproven techniques which need additional development.

We expect that, by 2/1/78, either the mechanical or the air handler will have demonstrated its superiority and the other handler will have been dropped. However, the mechanical handler could prove best for some applications, the air handler best for others.

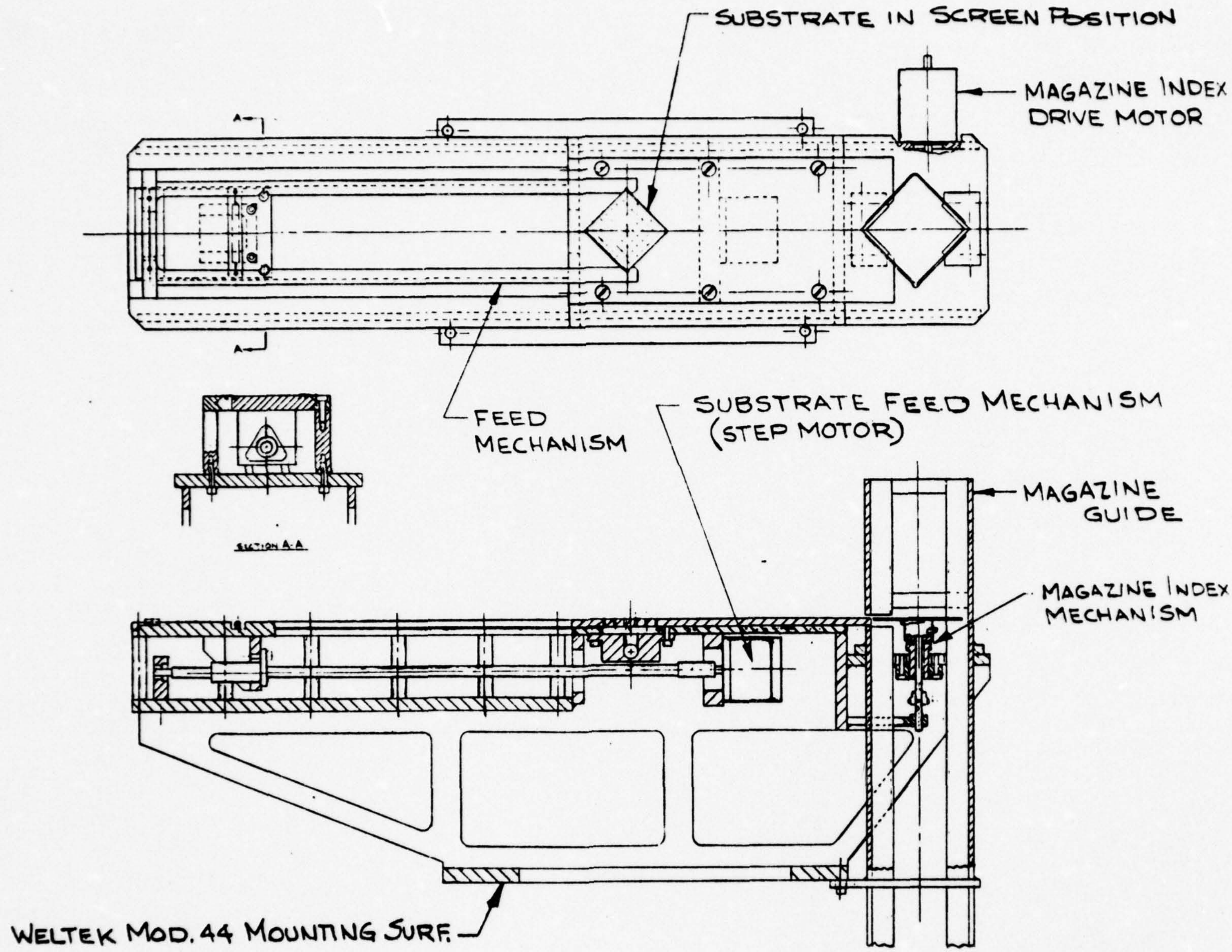

FIGURE 3-3. MECHANICAL AUTOMATIC HANDLING SYSTEM ADAPTED TO WELTEK PRINTHEAD

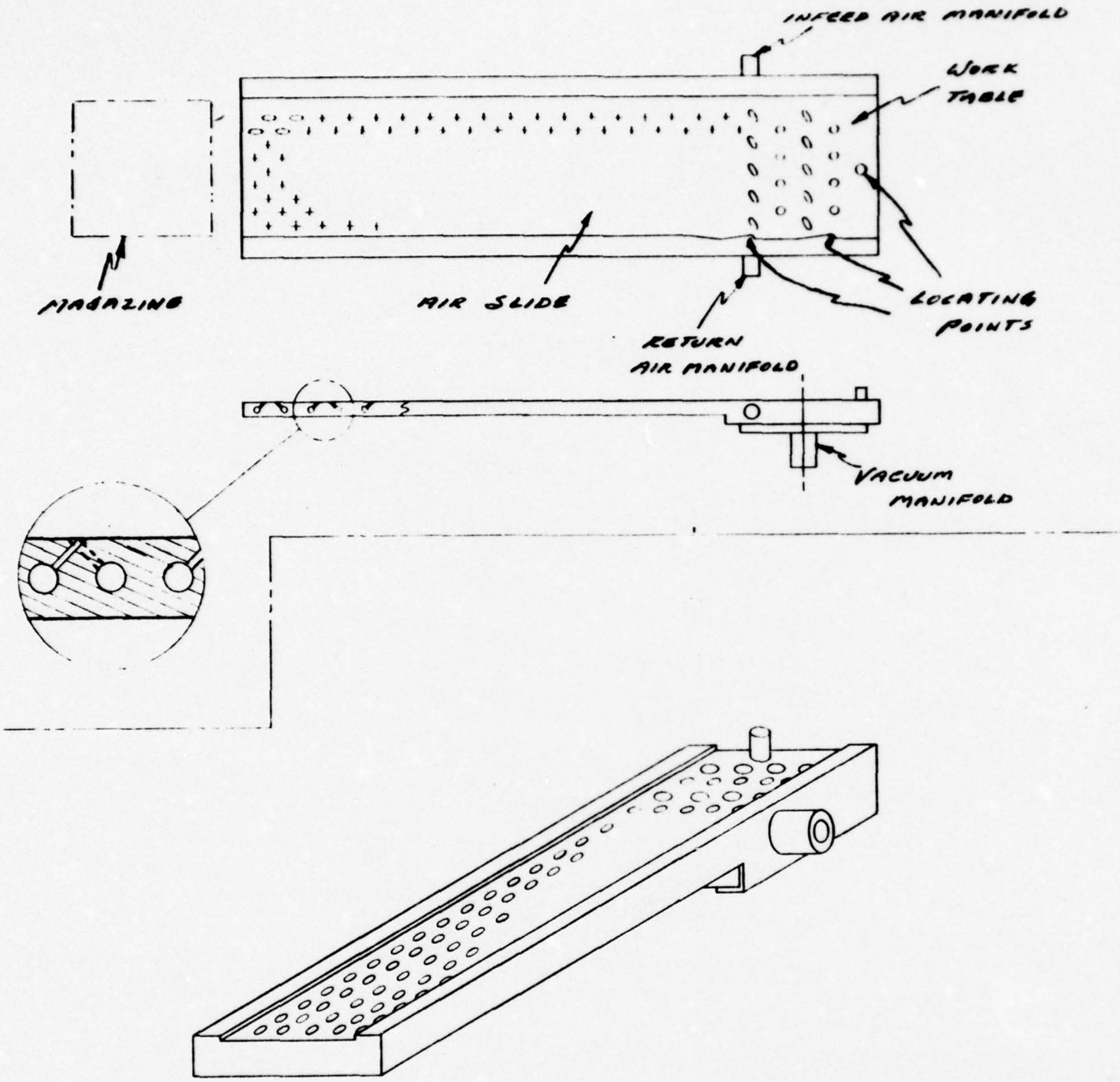

FIGURE 3-4. AIR AUTOMATIC SUBSTRATE HANDLER

Section 4

CONVENTIONAL PROCESS DEVELOPMENT

A number of activities in the area of conventional process development were planned on the PERT chart. With some of the circuit changes and early decisions in technical approaches, several of these efforts were redirected. The following is a brief summary of the work performed to date.

A. THICK FILM

A number of thick film printers available to this facility were evaluated against the requirements for the automatic assembly line. Also several vendors for new equipment were contacted and discussions were held. With the proposed change from the "FM Oscillator" to the "Temperature Controller" circuit, certain unique requirements for the printer could be deleted, and a printer more suitable for automated assembly could be selected. Available automatic feed systems mechanisms were not deemed accurate enough, and therefore a decision to build this system with the best printing characteristics. (See Section 1). A source for chip inductors was found, deleting the requirement to develop inductor printing technology.

B. CAPACITOR ATTACH

Because of the large number of capacitors in one of the circuits and because the circuits are built two or three at a time on a 2x2 inch substrate, a technique has to be developed to easily provide for multiple passes through the Browne pick and place machine. Capability of this equipment is currently 10 chips (capacitors or inductors) maximum at one pass.

C. INDUCTOR PLACEMENT

Since chip inductors will be used, these items can be handled by the Browne equipment. The review of requirements for proper size, orientations etc. has been completed and the desired chips have been selected.

D. AUTOMATIC WIRE BOND TESTS

With the selection of a 2x2 inch standard substrate rather than a larger, e.g. 4x4 inch substrate, the need for special wire bond tests over large areas has been obviated. The 2x2 inch substrate has been used in the past and sufficient experience was gained such that no special tests are necessary.

Section 5

TCC PROCESS DEVELOPMENT

A. STANDARD LEAD FRAME DESIGN AND BONDING PATTERNS

During this reporting period a set of standard lead frame trajectories and Outer Lead Bonding patterns was developed for use on all TCC bonded devices on either manual or automatic machines.

The purpose of this approach is to standardize the excise and forming dimensions for any chip size up to 0.250" square. Three standard dimensions are developed, corresponding to previously available tape window sizes of five and seven mm and a new window size of 10 mm. The basic concept of this approach is to excise the tape as close as possible to the Kapton window and to use all the available copper lead length to allow maximum chip dimensions for that window size. The excise dimension determines the outer lead bonding pad placement. For varying chip sizes fitting in a certain window size the lead shape remains constant up to the top of the S curve. See Figures 5-1, 5-2 and 5-3. The length of the remaining horizontal trajectory may increase with decreasing chip size. The lead does not have the one mil rise next to the bump allowing a larger chip for a certain window size, because the horizontal fan-out can start three mils from the bump rather than from the rise edge. The straight lead also allows for simpler tool design. The advantage of the standardization is that only three inserts are required for manual or automatic Outer Lead Bonders to cover a chip size range of 20 to 250 mils. Previously each chip size required its own excising size and lead form design and its own tooling inserts.

The bonding patterns are matched to accept leads excised and formed per Figures 5-4, 5-5 and 5-6. Prior patterns were adapted to each chip type and size used, resulting in a proliferation of bonding sizes. These standardized sizes are matched to the thick film preferred grid points, and they allow for via placement within the pattern.

The small size (Figure 5-4) measures 170 mils square and can accept chips up to 80 mils square, and up to 24 leads. The medium size pattern (Figure 5-5) measures 250 mils square and can accept chips up to 160 mils in largest dimension, and up to 40 leads. The large pattern (Figure 5-6) measures 350 mils and can accept 250 mil chips and up to 48 leads. The small pattern is designed so that, with 10 mil spacing between adjacent pads, and 50 mil spacing from the edges, exactly five patterns fit on a one inch substrate length. With the same 10 mil spacing exactly two small patterns fit in the space of one large pattern.

B. MASSBOND 4810 OUTER LEAD BONDER

The Jade Massbond 4810 manual outer lead bonder was delivered and

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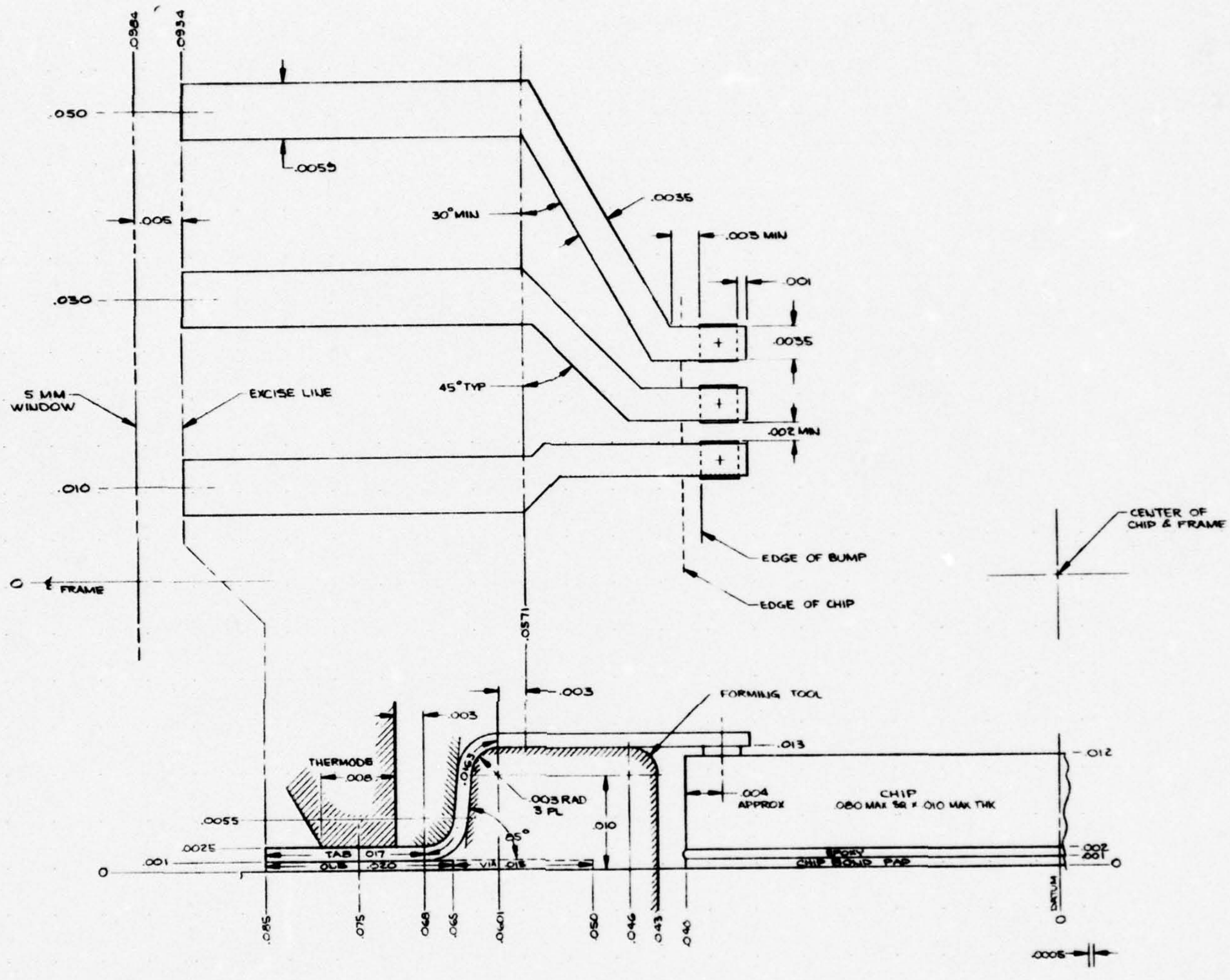

FIGURE 5-1. STANDARD LEAD FORMING CONFIGURATION (SMALL)

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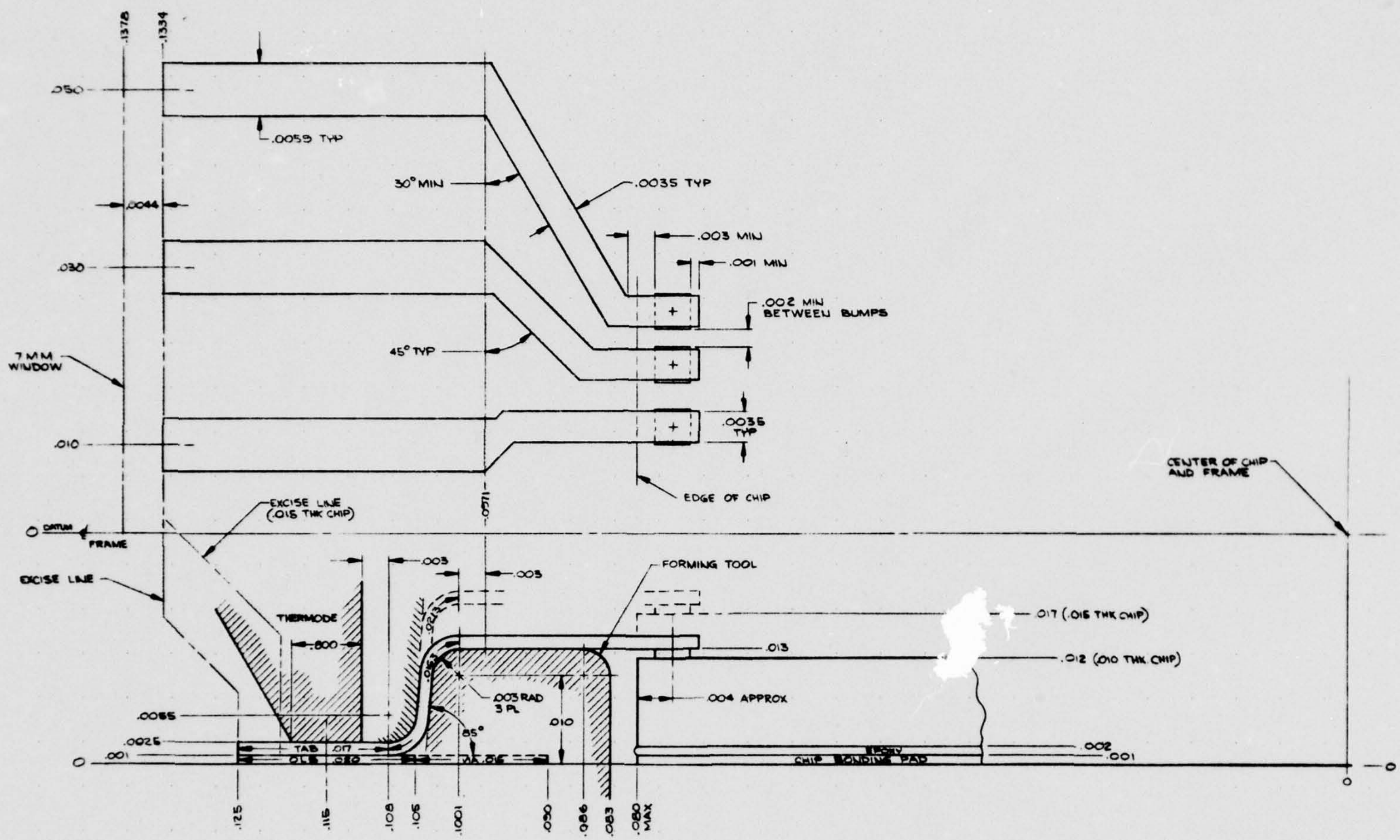

FIGURE 5-2. STANDARD LEAD FORMING CONFIGURATION (MEDIUM)

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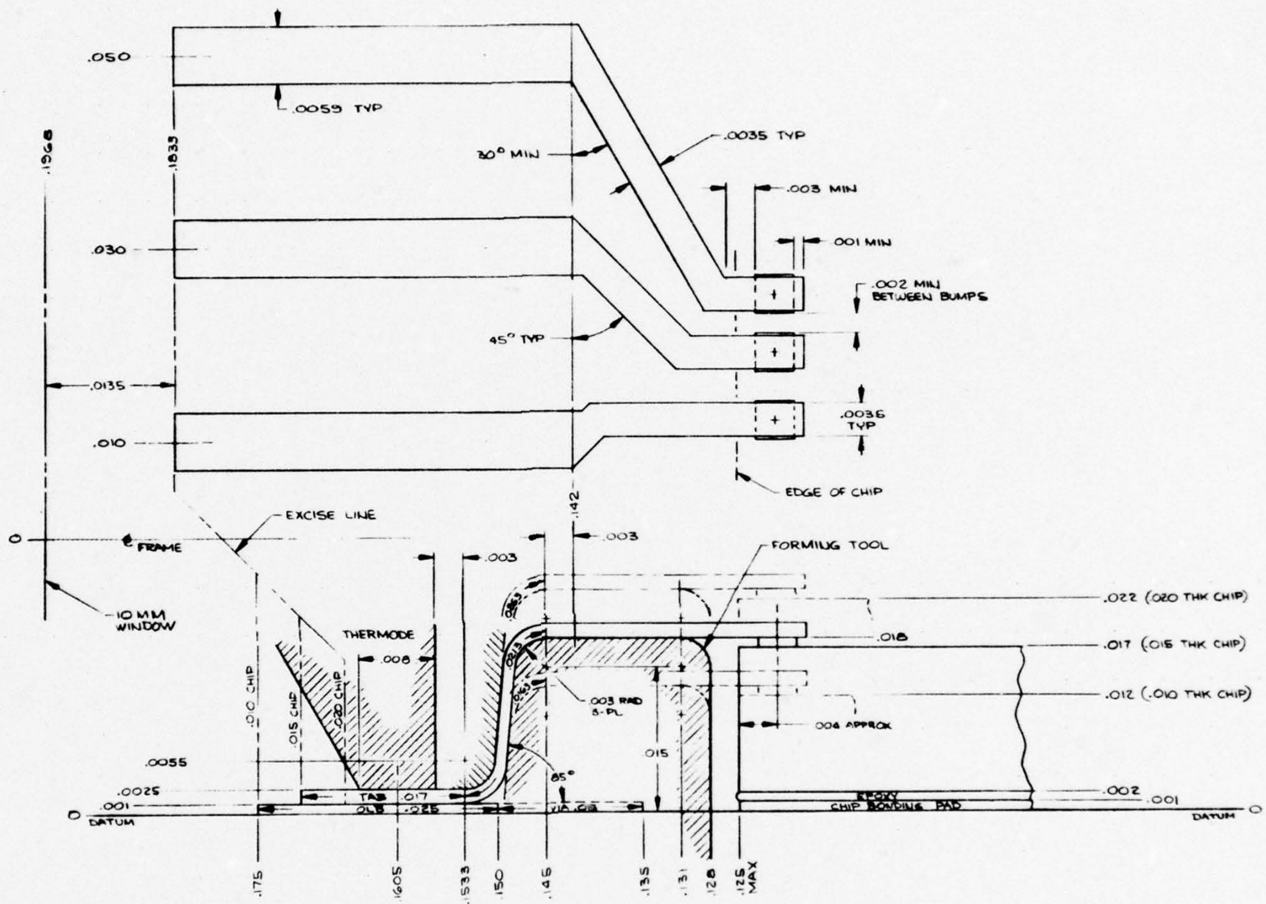

FIGURE 5-3. STANDARD LEAD FORMING CONFIGURATION (LARGE)

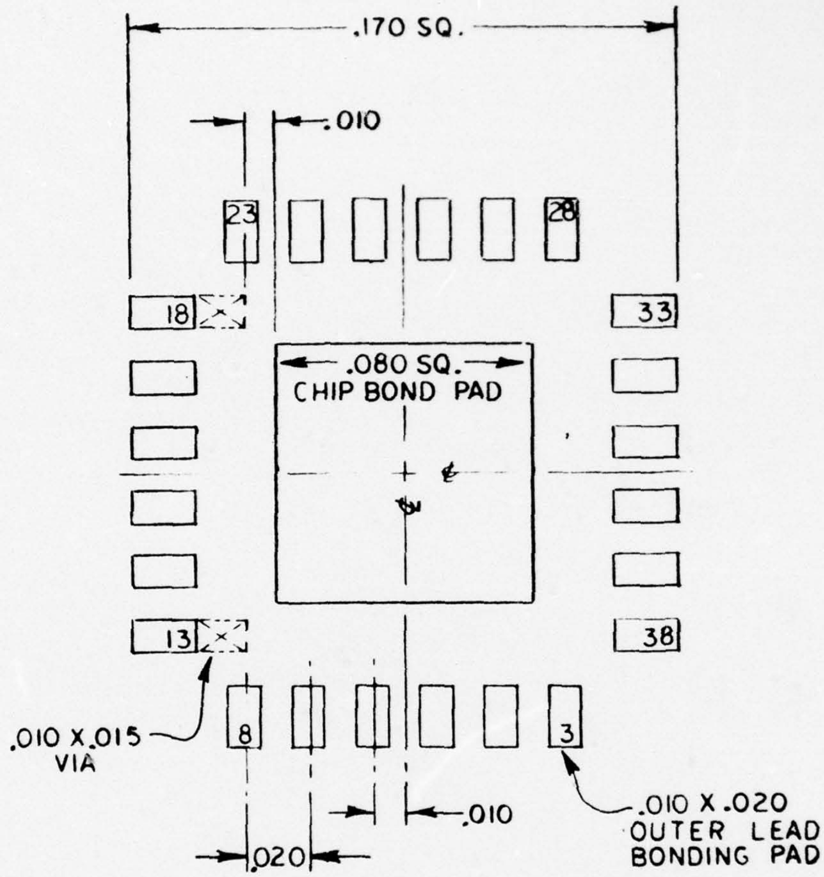

FIGURE 5-4. SMALL OUTER BOND (SOB) PATTERN

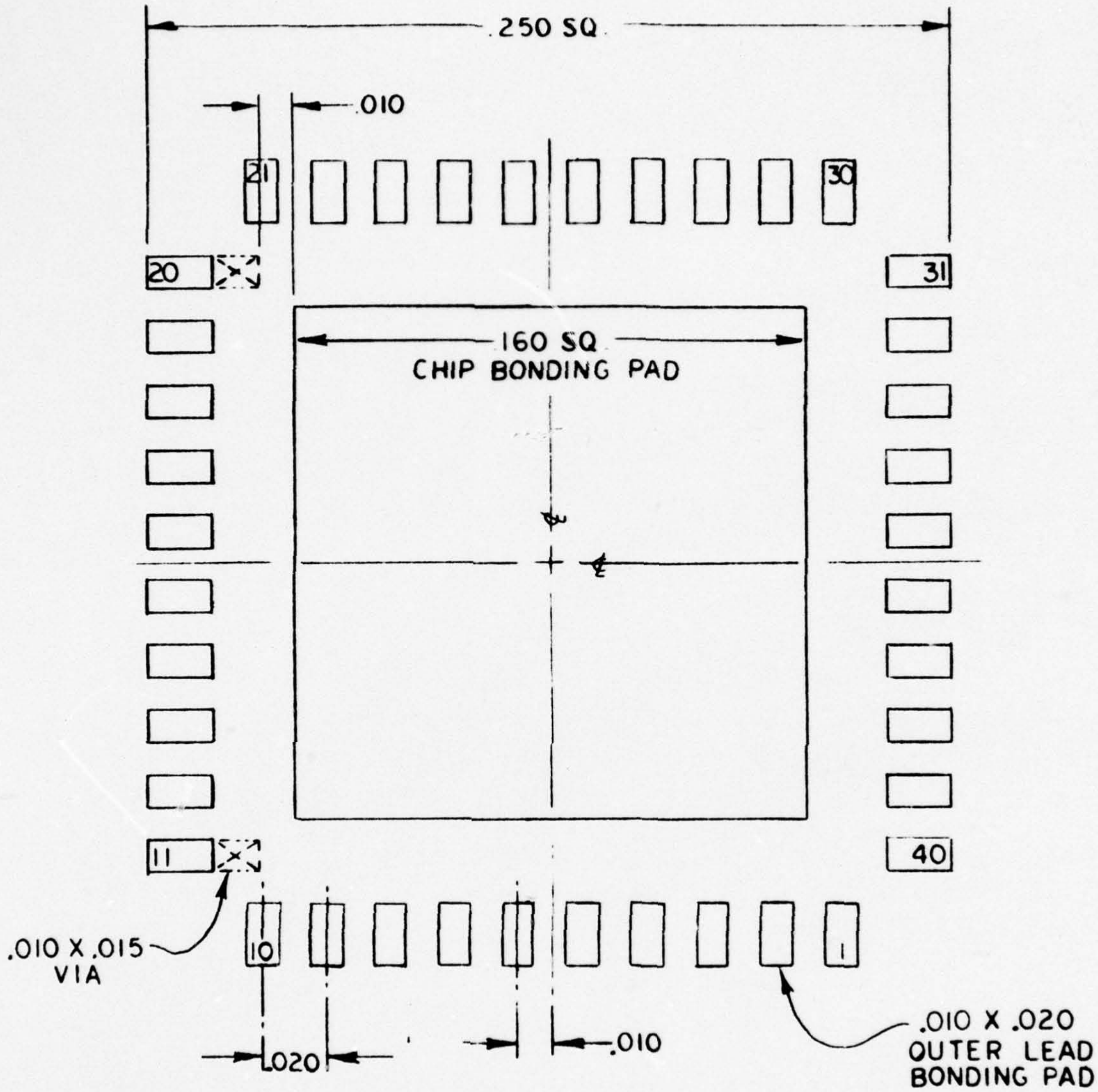

FIGURE 5-5. MEDIUM OUTER BOND (MOB) PATTERN

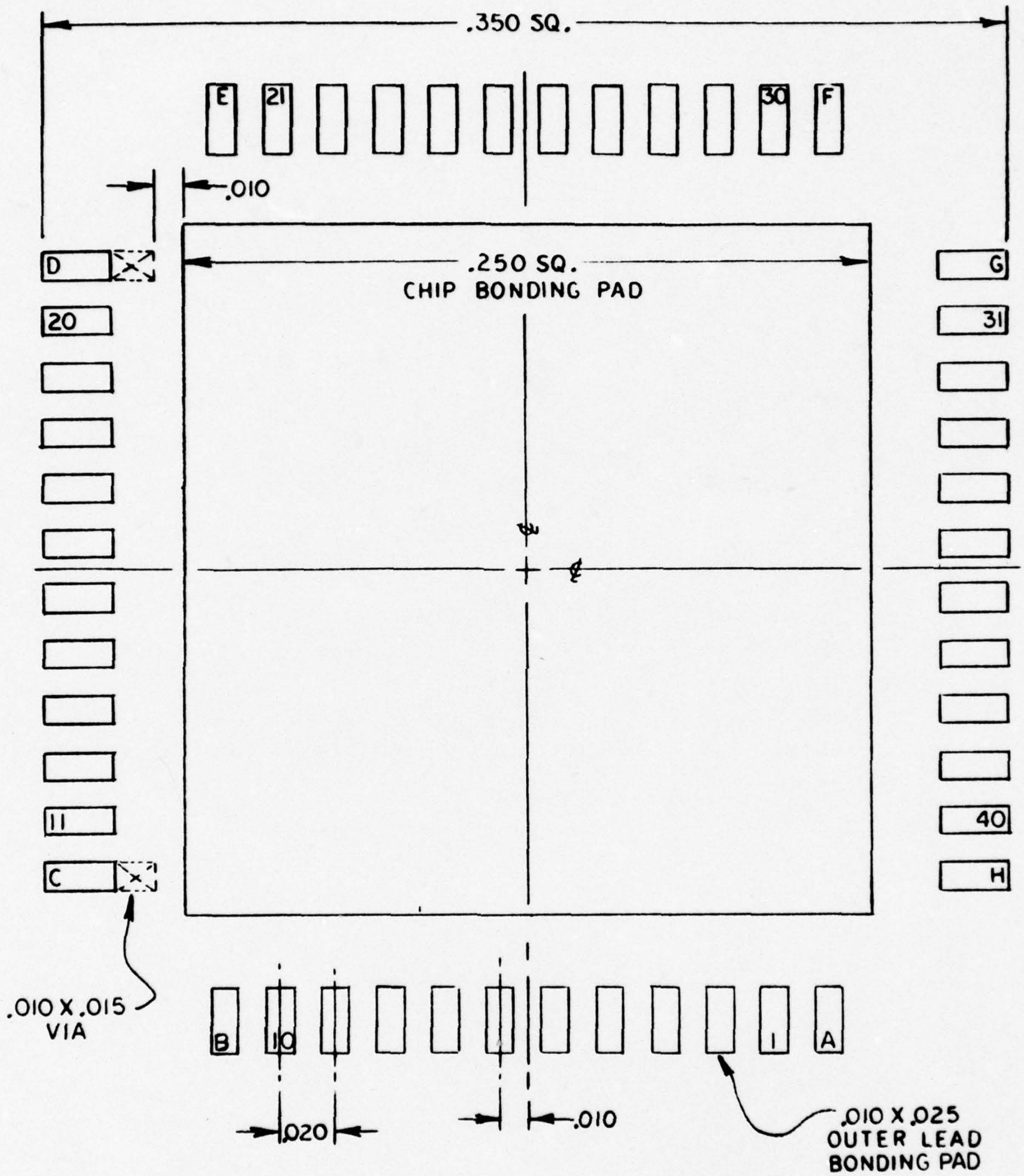

FIGURE 5-6. LARGE OUTER BOND (LOB) PATTERN

installed. This equipment is important to the development of automatic bonding capability because the excising, forming and bonding steps it performs as an integral function will be carried out in the same manner on the automatic bonder. The Jade Corporation will draw heavily on Honeywell's experience with this bonder in order to prepare the final design for the automatic bonder. Experimentation on this bonder will continue well into the next reporting period.

C. WAFER BUMPING

The Riston division of DuPont has announced that no more microelectronics films will be produced. Riston is interested in pursuing the microelectronics business which it has started; however, their approach will be to use "standard" dry-film resists. Reasons for their decision to drop the line of M-films are:

- High cost of these films (3 to 4 times higher than standard).
- Low volume production of M-films requires special order.
- Benefits of M-films over standard films are questionable.

The standard film which replaces M-811 is 211-R. This is also a red semi-aqueous, one mil thick dry film. The Riston Microelectronics Research and Development Department has assured us that no processing problems should be encountered when switching to 211-R.

No wafer bumping operations were performed during this reporting period, as the first submittal of engineering samples will be wire bonded.

Section 6

DESIGN, LAYOUT AND MANUFACTURE OF ENGINEERING SAMPLES

Upon receipt of the technical specification package of the Engineering Samples a review was made of each circuit schematic and description in preparation of the layout effort. During this review it became apparent that the schematics could not be immediately translated into circuit layouts and that considerable circuit design engineering effort was required. Below follows a description of the work performed and a summary of the results.

A. ELECTRONIC COMMUTATOR (34030402)

Work performed on this circuit included the following items: (1) Timing diagram preparation and state analysis, (2) Breadboard testing of actual circuit.

A number of problems found with the Electronic Commutator are discussed below. Figure 6-1 shows the final circuit schematic. Figure 6-2 shows the layout configuration in which the device is being built. Figure 6-3 is the accompanying parts list.

1. A connection error on the schematic submitted in the data package is causing uneven switch times in the commutator output. Signals to U4 (CD4023) which are $\overline{A}\ \overline{B}\ \overline{C}$ and $A\ B\ \overline{C}$, should be $\overline{A}\ \overline{B}\ \overline{C}$ and $\overline{A}\ \overline{B}\ C$. In order to correct this a new layout on the conductor pattern on the substrate would be required.

2. A "glitch" was observed in the oscillator output during breadboard testing (U3 pin 9). It may be attributed to layout problems, i.e., long lead lengths. A 20 pf capacitor pin 11, 12, and 13 on U3 to ground corrected the problem on the breadboard. The "glitch" may yet be present on the hybrid.

3. The FET "off" resistance specification may not be met due to Vpd being specified at 7.5 volts. The 2N4391 guaranteed "off" voltage is Vgo (off) = -4V to -10V for $I_o = 1 \times 10^{-9}$ amps. It is not known at this time how many devices would meet 150 ma with a gate voltage of -7.5V and a drain voltage of 15V, i.e., $15V/150 \times 10^{-9}a = 100$ M ohm which is the specification. If this is a problem, devices could be screened at the chip level to meet the specification.

4. The output numbering is confusing, the time sequence of switching is ..., 6, 5, 4, 3, 2, 1, 6, 5, ... etc.

5. To meet the switching requirement of $T_C = 0.375 \pm 0.025$ second R8 may have to be actively trimmed.

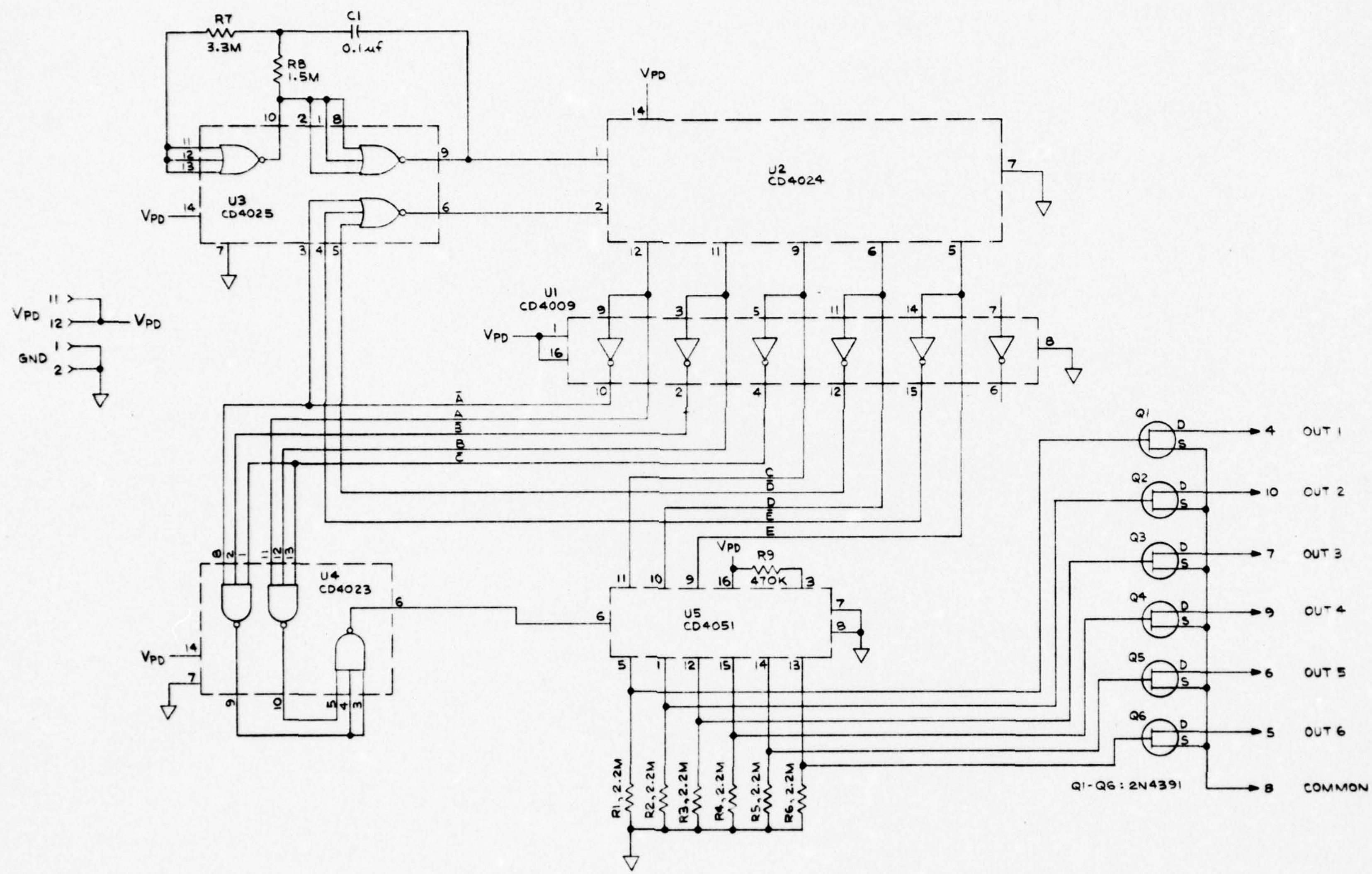

FIGURE 6-1. ELECTRONIC COMMUTATOR SCHEMATIC

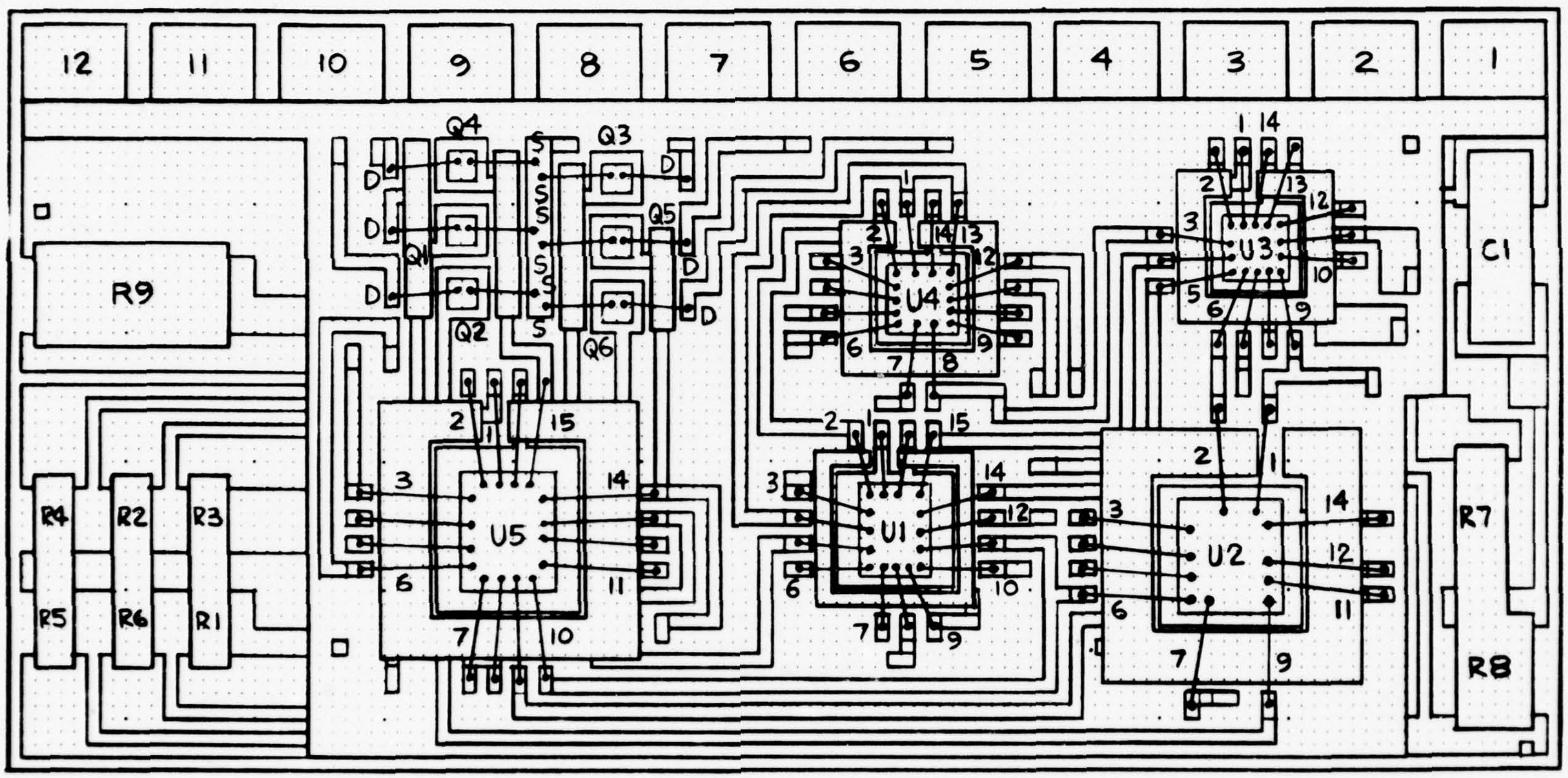

FIGURE 6-2. ELECTRONIC COMMUTATOR CIRCUIT LAYOUT

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PARTS LIST	HONEYWELL AVIONICS DIVISION ST. PETERSBURG FLORIDA	CODE IDENT 09128 PL34030402-001	REV A	DATE 11-09-77
CONTRACT NUMBER		LIST TITLE HYB. ASSY, ELEC COMM	REV AUTH NO. E0155530	SHEET 1

FIND NO	QTY	PART NUMBER	DESCRIPTION	REMARKS	CODE IDENT
	REF	34030402	HYB. ASSY. ELEC COMM	MIN REVISION -	
1	1	34030401-001	M.I.B. ELEC. COMM		
2	1	150545R104K25PS	CAP. 0.1UF. 25V	C1	
3	6	AU PAD 2N4391	JFET	Q1-Q6	
4	1	T.A.B. CD4009	T.A.B. I.C.	U1	
5	1	T.A.B. CD4024	T.A.B. I.C.	U2	
6	1	T.A.B. CD4025	T.A.B. I.C.	U3	
7	1	T.A.B. CD4023	T.A.B. I.C.	U4	
8	1	T.A.B. CD4051	T.A.B. I.C.	U5	
9	AR	FMS40599	EL.COND.EPOXY ADH.	TY II ABLEBOND 36-2	
10	AR	FMS40616	WIRE.BOND.GOLD	.001 DIA.TY II.T.S.	
11	AR	DUPONT 8956	SOLDER PASTE	62-36-2	
12	AR	96100	COAT.CONFORMAL	DOW CORNING	
REF	REF	FPS13032	MARKING	.09 REF. HIGH CHAR. METH H5 AND/OR B2	09128
REF	REF	34030403	TEST		

FIGURE 6-3. ELECTRONIC COMMUTATOR PARTS LIST

B. RANDOM ACCESS MEMORY (34030405)

Work performed on the RAM included breadboard testing on the Microdata 150 automatic tester in order to verify the test program. No other analysis was required. There are no apparent problems with the device at this time. The testing will be quite a challenge, however. The test specification will be determined from GALPAT program modifications.

It should be noted that the memory is not the same functionally as proposed in 177-14222 but similar.

As originally proposed the 16K RAM used 16-1K AM9102B memory chips. Because of AM9102B chip availability problems, the readily available SY2114 4K chips were chosen as a suitable replacement. To achieve 16K bit density only 4 SY2114 chips are required. The major difference in the resulting memory system is the SY2114 chip has a common I/O while the AM9102B has separate input and output. Most modern memory systems are standardizing on 18 pin common I/O chips so it was reasoned that the substitution would be acceptable.

The RAM circuit schematic is shown in Figure 6-4. The hybrid layout in Figure 6-5, and the accompanying parts list in Figure 6-6.

C. SINCGARS DISCRIMINATOR (34030408)

Circuit analysis work performed on the Discriminator circuit included (1) HICAP analysis on the output active filter, and (2) a breadboard test of the actual circuit.

No particular problems are foreseen at this time. The original schematic had a wiring error and choice of components to be made, however, the wiring error has been corrected and inductance values chosen. The breadboard is operational and will be used to establish test parameter values for a test specification to be written.

The original circuit description (Figure 4 per description 2279857 B&C dated 17 August 1976) had C11, which is the output, grounded, and had 22 nh chokes in the circuit for bypassing. L1, L4 and L5 are used in conjunction with C4, C8 and C9 respectively. C8 and C9 are 0.01 μf caps which resonate with 22 mh at 10.7 MHz which is not a desirable condition for bypassing. It was argued that due to the small current draw of the amp/limitor chip RC bypassing could be used.

With regards the unspecified values of L2 (the quadrature coil) and L3 (the tuning coil) the commercially accepted values of 22 μh and 2.2 μs were used. (Reference RCA application note ICAN 6257 "Application of the CA3089E-IF Subsystem" by L.S. Baar.) The connection between L2 and L3 is also missing on Figure 4 and is added on the 34030408 schematic. Minor rewiring in the AC return connection of C3 was also made.

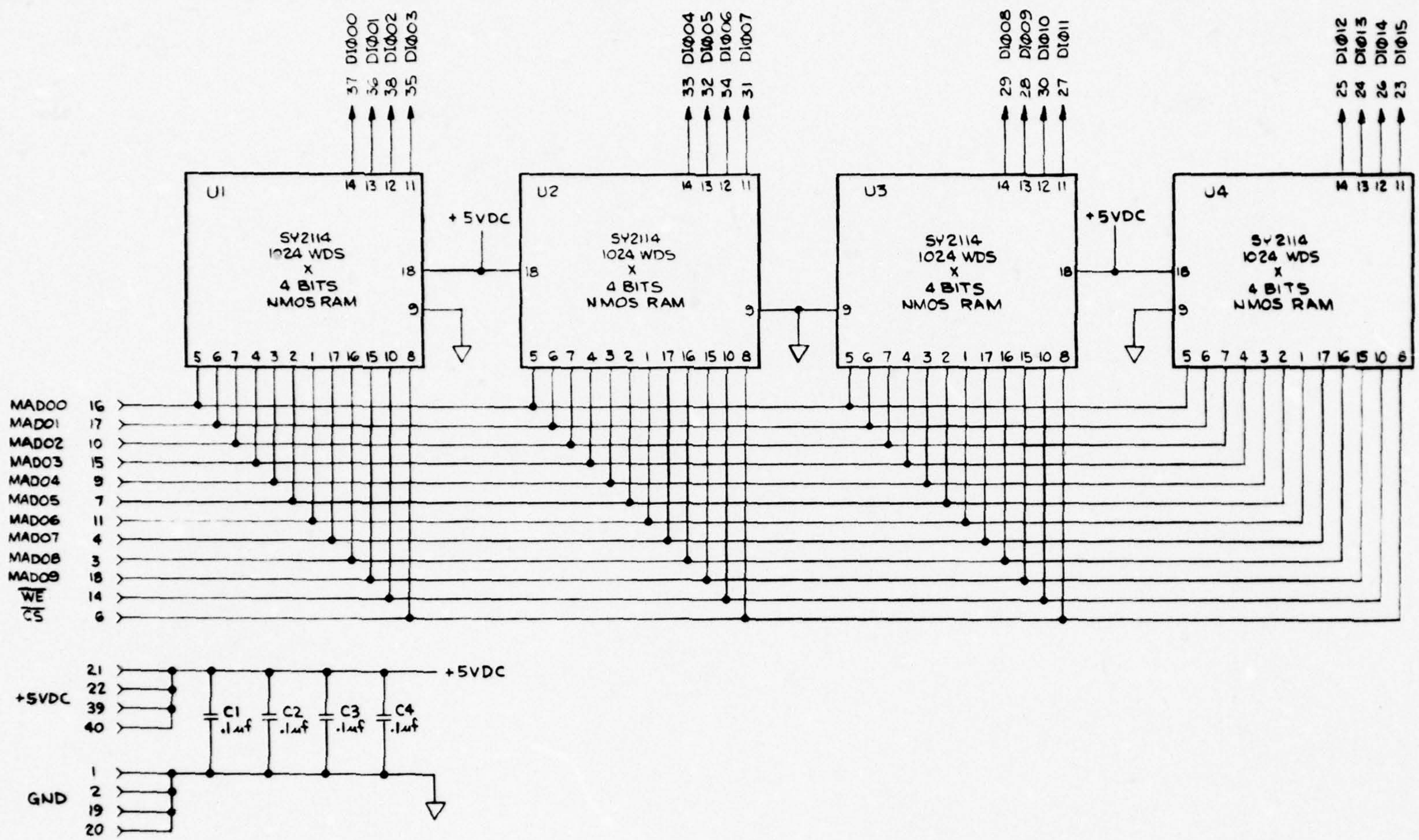

FIGURE 6-4. RAM SCHEMATIC

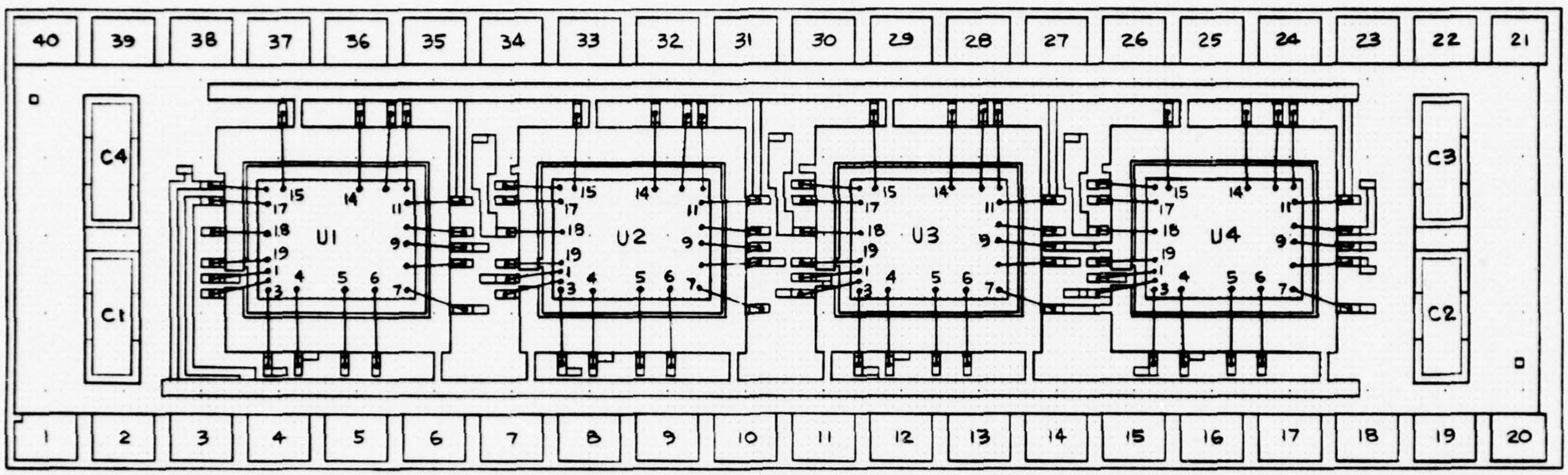

FIGURE 6-5. RAM CIRCUIT LAYOUT

PARTS LIST — HONEYWELL AVIONICS DIVISION, ST. PETERSBURG FLORIDA — CODE IDENT 09128 — PL34030405-001 — REV A — DATE 11-09-77

CONTRACT NUMBER

LIST TITLE HYB. ASSY. MM+T RAM — REV AUTH NO. E0155530 — SHEET 1

FIND NO	QTY	PART NUMBER	DESCRIPTION	REMARKS	CODE IDENT
	REF	34030405	HYB. ASSY. MM+T RAM	MIN REVISION -	
1	1	34030404-001	M.I.B. MM+T RAM		
2	4	15050.5P104K25PS	CAP. 0.1UF. 25V	C1-C4	
3	4	T.A.B. SY2114	TAB. I.C.	U1-U4	
4	AR	FMS40599	EL.COND.EPOXY ADH.	TY II ABLEBOND 36-2	
5	AR	DUPONT 8956	SOLDER PASTE	62-36-2	
6	AR	P6100	COAT.CONFORMAL	DOW CORNING	
REF	REF	FPS18032	MARKING	.09 REF. HIGH CHAR. METH H5 AND/OR B2	09128
REF	REF	34030406	TEST		

FIGURE 6-6. RAM PARTS LIST

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With regards the electrical requirements minor deviations in the specification for detector output and total harmonic distortion (THD) may have to be made as the choice of L2 and L3 effects these parameters.

The resulting schematic for the Discriminator is shown in Figure 6-7. The layout to which the hybrid will be built is shown in Figure 6-8, and the parts list in Figure 6-9.

D. MINILASER COUNTER (3403041)

A logic state analysis was performed on the Minilaser Counter. No problems are foreseen with this circuit at this time. The circuit schematic is shown in Figure 6-10. The hybrid layout which will be used is shown in Figure 6-11, and the parts list in Figure 6-12.

E. CRYSTAL OSCILLATOR (34030418)

The circuit analysis work to be performed on this circuit includes a (1) HICAP IIA ANALYSIS AND (2) a headboard test. Much preliminary design and review work has been completed. The performance of this circuit will be strongly dependent on the choice of piezoelectric element. The actual ceramic element, packaged as developed by ECOM will not be available nor will a complete procurement specification for an equivalent unit in a Hg-18/n case. Room on the substrate will be provided for the actual ceramic element should it become available. Some of the performance characteristics such as frequency deviation, temperature tracking of CR1 with the crystal element and compensation temperature range will have to be determined after testing the original engineering units.

F. TEMPERATURE CONTROLLER (34030415)

A basic circuit analysis has been completed on this circuit, which is the temperature controller portion of the Crystal Oscillator. Yet to be performed are (1) a HICAP IID circuit analysis and (2) breadboard build and test.

MANUFACTURING SCHEDULE OF FIRST LOT ENGINEERING SAMPLES

Figures 6-13 through 6-16 show the manufacturing schedules of the Electronic Commutator, RAM, SINCGARS Discriminator and Minilaser Rangefinder circuits respectively. Manufacturing schedules for the last two circuits will be prepared as soon as the circuit definition has been approved.

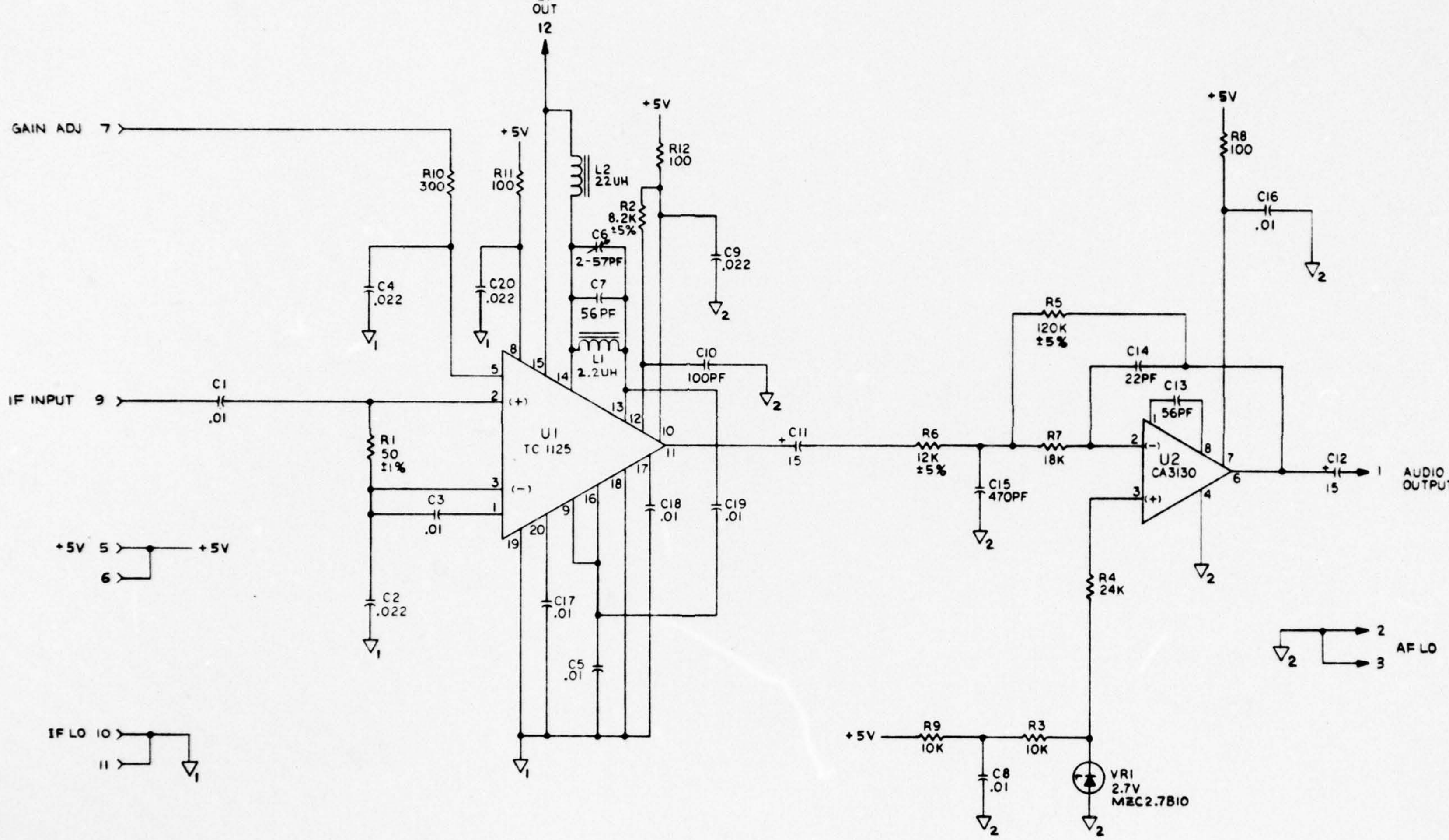

FIGURE 6-7. SINCGARS DISCRIMINATOR SCHEMATIC

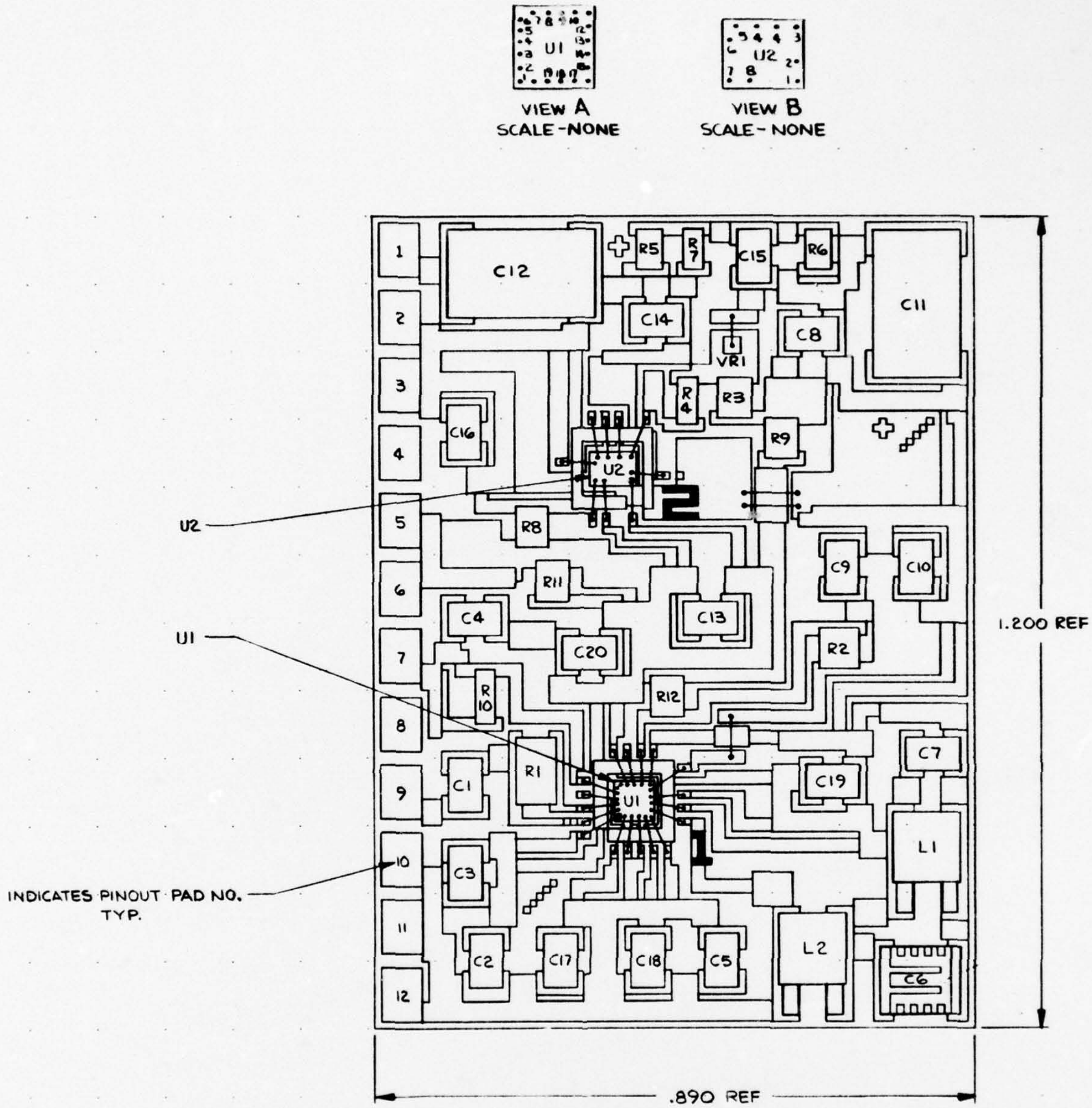

FIGURE 6-8. SINCGARS DISCRIMINATOR CIRCUIT LAYOUT

PARTS LIST — HONEYWELL AVIONICS DIVISION, ST. PETERSBURG FLORIDA — CODE IDENT 09128 — PL34030408-001 — REV A — DATE 12-07-77

CONTRACT NUMBER — LIST TITLE: HYB. ASSY. SINC. DISC. — REV AUTH NO. ED155529 — SHEET 1

FIND NO	QTY	PART NUMBER	DESCRIPTION	REMARKS	CODE IDENT
	1	34030408	HYB. ASSY. SINC. DISC.	MIN. REVISION -	
1	1	34030407-001	M.I.B.,SINCGARS DISCRIM.		
2	8	0805X5R103K50PS	.01 UF CAP	VICLAN C1,3,5,8, 16-19	
3	4	0805X5R223K50PS	.022 UF CAP	VICLAN C2,4,9,20	
4	2	0805C0G560K50PS	56 PF CAP	VICLAN C7,C13	
5	1	0805C0G101K50PS	100 PF CAP	VICLAN C10	
6	1	0805C0G220K50PS	22 PF CAP	VICLAN C14	
7	1	0805C0G471K50PS	470 PF CAP	VICLAN C15	
8	2	CWR06FA156KM	15 UF TANT CAP	MCI C11,C12	
9	1	VC2A2R0S4A4A	2 TO 57 PF VAR. CAP	VITRAMON C6	
10	1	30028	2.2 UH INDUCTOR	VANGUARD L1	
11	1	30040	22 UH INDUCTOR	VANGUARD L2	
12	1	1MC4618	DIODE	VR1 MOTOROLA	
13	1	T.A.B. TC1125H	T.A.B.,I.C.	RCA U1	
14	1	T.A.B. CA3130H	T.A.B.,I.C.	RCA U2	
15	AR	FMS40599	EL.COND.EPOXY ADH.	F/N 15, TYPE I, ABLEBOND 58-1 F/N 16, TYPE II, ABLEBOND 36-2	
17	AR	FMS40616	WIRE,BOND,GOLD	.001 DIA.TY II.T.S.	
18	AR	DUPONT 8956	SOLDER PASTE	62-36-2	
19	AR	P6100	COAT,CONFORMAL	DOW CORNING	
REF	REF	34030409	TEST		
REF	REF	FPS18032	MARKING	METH H5 AND/OR B2	09128

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FIGURE 6-9. SINCGARS DISCRIMINATOR PARTS LIST

PROJECT

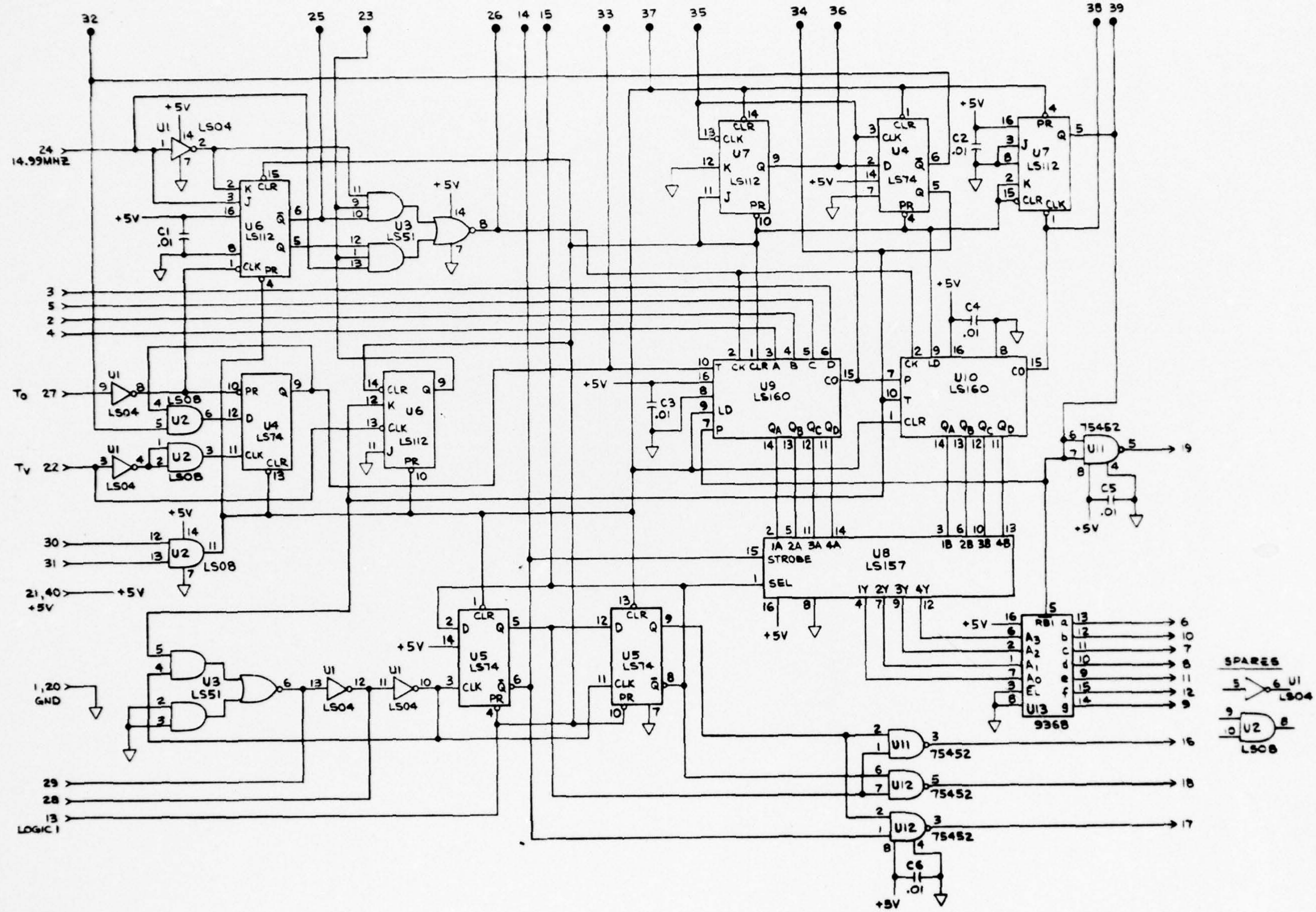

FIGURE 6-10. MINILASER COUNTER SCHEMATIC

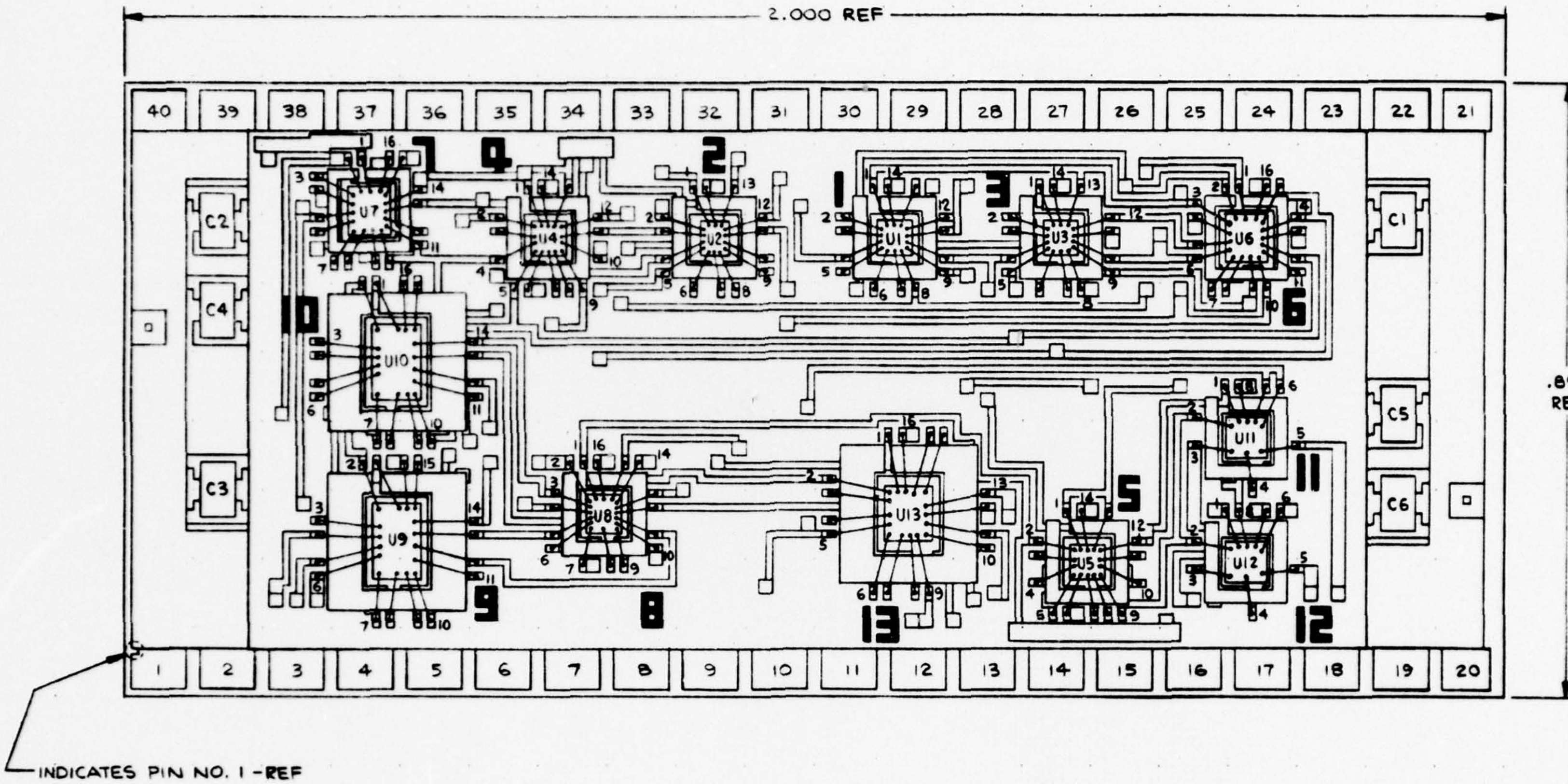

FIGURE 6-11. MINILASER CIRCUIT LAYOUT

PARTS LIST	HONEYWELL AVIONICS DIVISION ST. PETERSBURG FLORIDA	CODE IDENT 09128	PL34030411-001	REV -	DATE 11-11-77
CONTRACT NUMBER		LIST TITLE HYB.ASSY MINILASER COUNT		REV AUTH NO. E0155528	SHEET 1

FIND NO	QTY	PART NUMBER	DESCRIPTION	REMARKS	CODE IDENT
	REF	34030411	HYB.ASSY MINILASER COUNT	MIN REVISION -	
1	1	34030410-001	M.I.B.MINILASER COUNTER		
2	6	0805W5R103K50PS	.01 UF CAP	VICLAN C1-C6	
3	1	T.A.B. 54LS04	T.A.B. I.C.	NAT U1	
4	1	T.A.B. 54LS08	T.A.B. I.C.	NAT U2	
5	1	T.A.B. 54LS51	T.A.B. I.C.	NAT U3	
6	2	T.A.B. 54LS74	T.A.B. I.C.	NAT U4,U5	
7	2	T.A.B. 54LS112	T.A.B. I.C.	NAT U6,U7	
8	1	T.A.B. 54LS157	T.A.B. I.C.	NAT U8	
9	2	T.A.B. 54LS160	T.A.B. I.C.	NAT U9,U10	
10	2	T.A.B. 75452	T.A.B. I.C.	FAIR U11;U12	
11	1	T.A.B. 9368	T.A.B. I.C.	FAIR U13	
12	AR	FMS40599	EL.COND.EPOXY ADH.	TY II,ABLEBOND 36-2	
13	AR	DUPONT 8956	SOLDER PASTE	62-36-2	
14	AR	R6100	COAT,CONFORMAL	DOW CORNING	
REF	REF	FPS18032	MARKING	.09 REF HIGH CHAR. METH H5 AND/OR B2	09128
REF	REF	34030412	TEST		

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END OF REPORT

FIGURE 6-12. MINILASER PARTS LIST

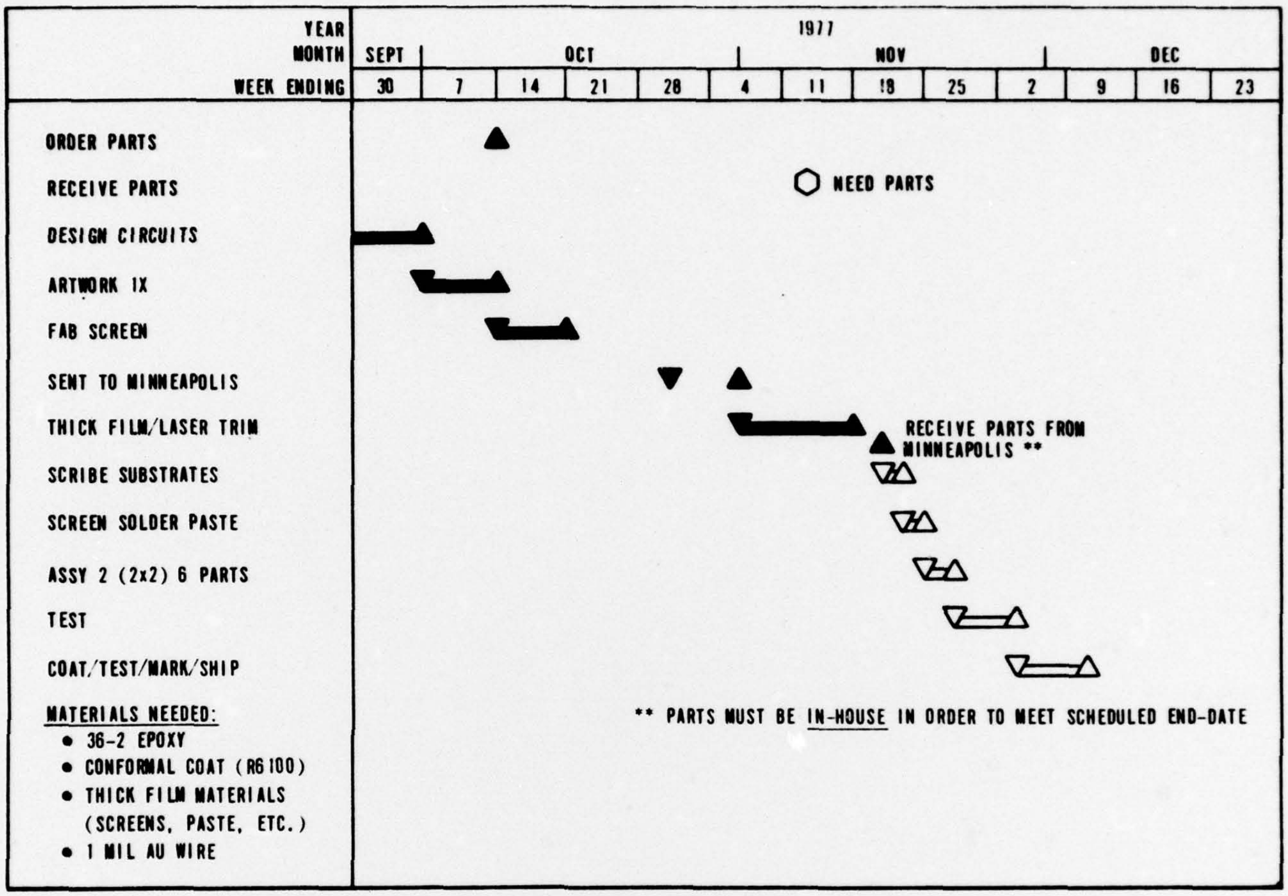

FIGURE 6-13. ELECTRONIC COMMUTATOR SCHEDULE

0178-3758

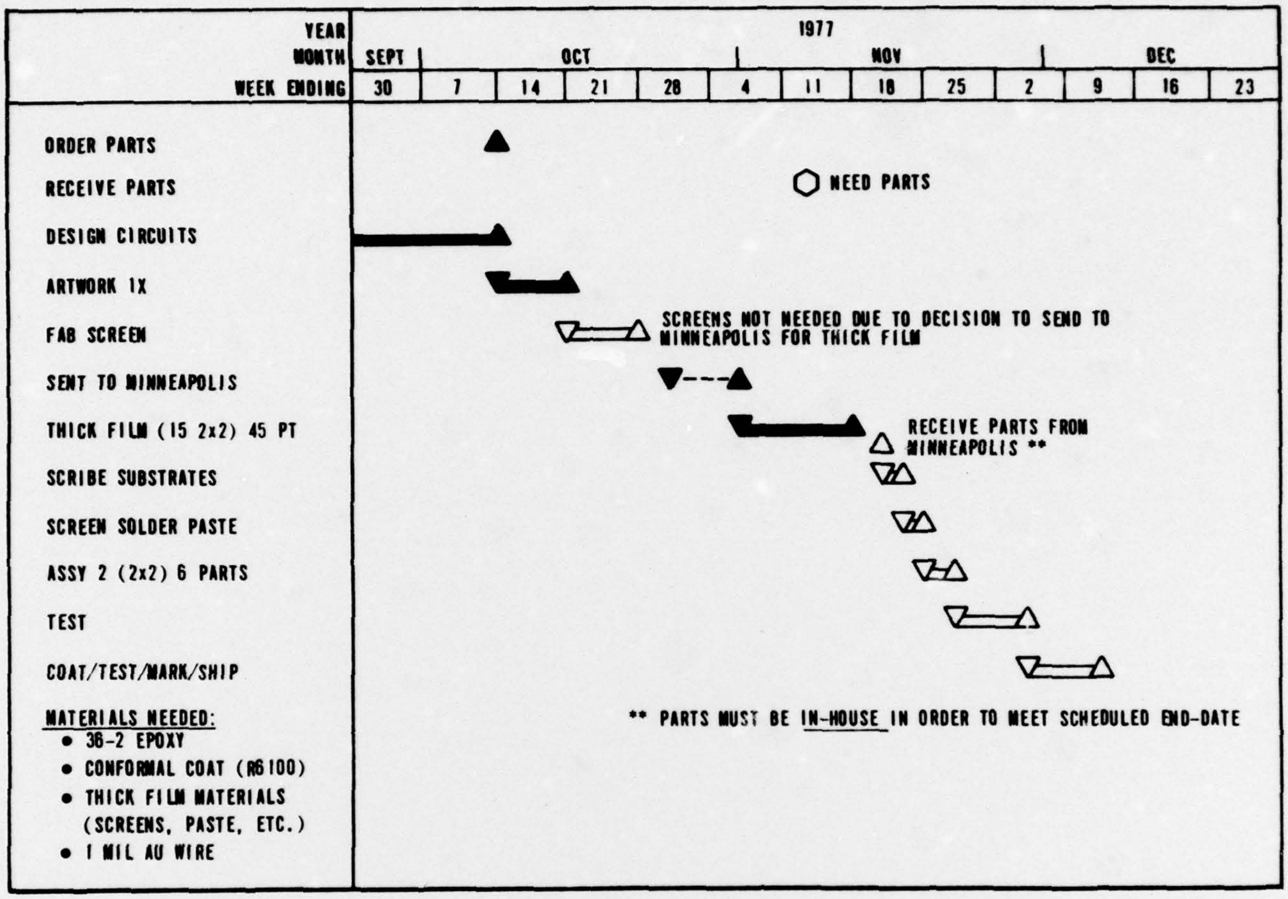

FIGURE 6-14. RAM SCHEDULE

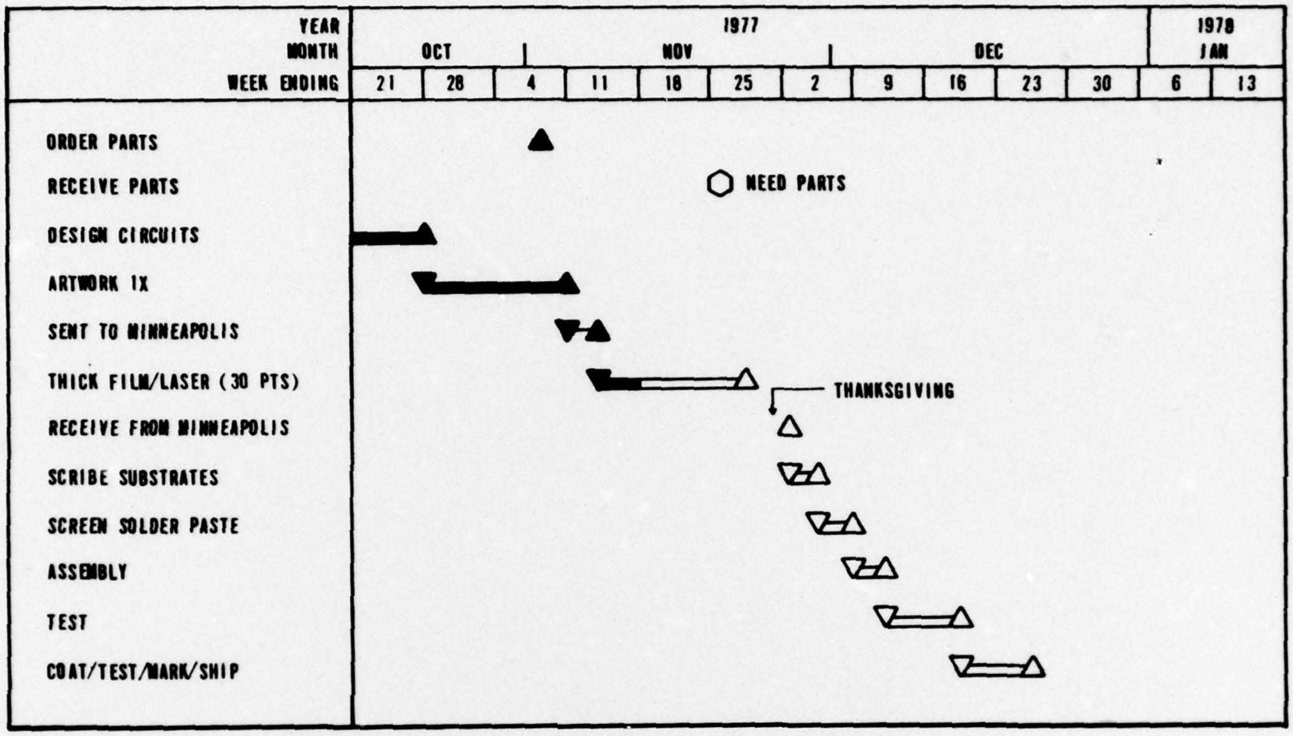

FIGURE 6-15. SINCGARS DISCRIMINATOR SCHEDULE

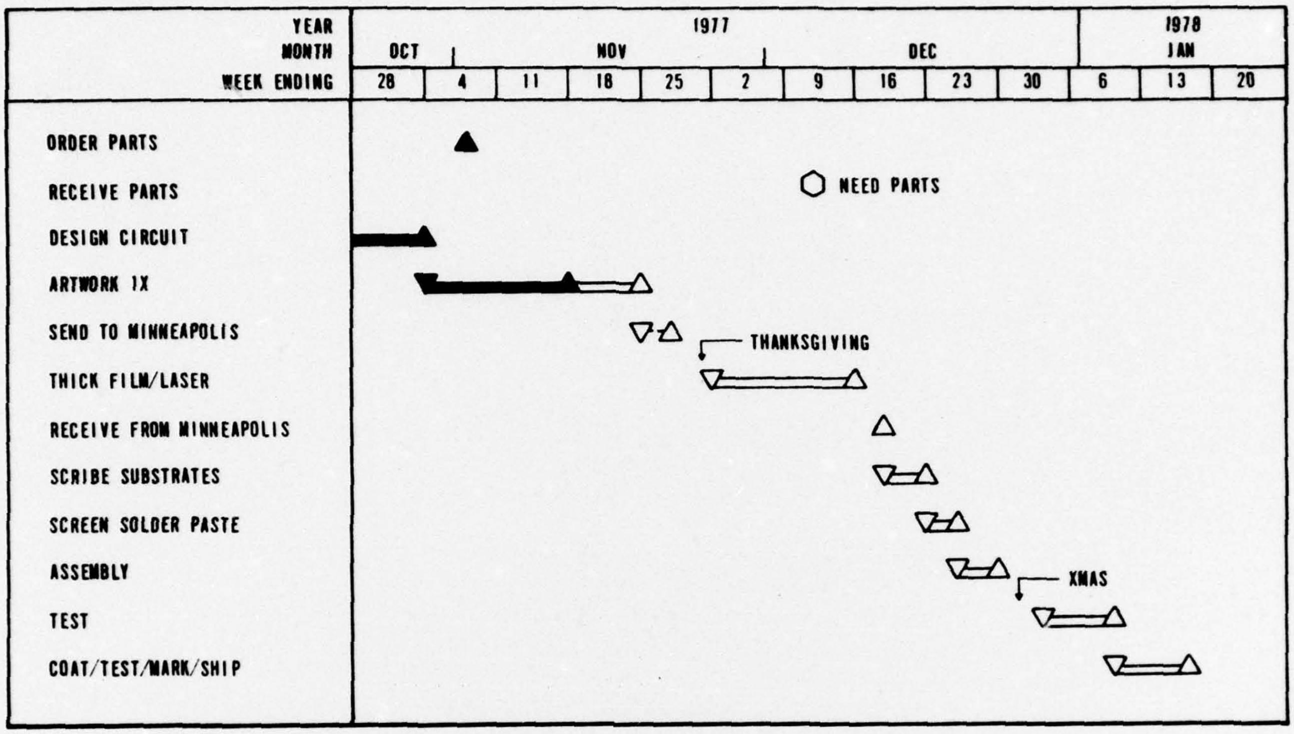

FIGURE 6-16. MINILASER COUNTER SCHEDULE

CONCLUSIONS

During this first reporting period excellent progress was made in all areas of endeavor. The equipment definition and specification work is proceeding on schedule with no major problems foreseen at this time. The facility requirements are being reviewed for more detailed determination during the next reporting period. The material handling system design is ahead of schedule with good progress in two parallel approaches: the mechanical feed system and the air feed system. Both designs show so much promise that neither has been dropped at this time. Conventional process development is on schedule and should be largely completed by the close of the next reporting period. TCC process development is progressing on schedule with the definition of standard OLB Patterns and lead forming configurations. The design, layout and manufacture of engineering samples is progressing close to schedule, with the first four circuits expected to be delivered before or on 31 December 1977. The last two devices will see delivery in January 1978. Significant design effort was expended on all six device types and satisfactory technical approaches have been identified. The overall program is close to schedule.

PLANS FOR NEXT REPORTING PERIOD

During the next reporting period engineering, design and layout activity of the six Engineering Sample devices should have been completed. At least four of the circuits are scheduled to be delivered with the last two to follow shortly. The mechanical and air feed material handling system design will have been completed. The first prototype of the mechanical feed system, adaptable to the Weltek printhead will be nearing completion. Most major equipment specifications will have been written, and appropriations to order will have been prepared. Detail design of the burn-in equipment will have been initiated.

PUBLICATIONS

(1) "Advances in TAB for Hybrids - TC OUter Lead Bonding". William R. Rodrigues de Miranda and Dr. R. G. Oswald

(2) "Wafer Bumping for Tape Automated Bonding". James M. Montante, William R. Rodrigues de Miranda and Dr. Rudolph G. Oswald

Both papers were presented at the 1977 ISHM International Symposium in Baltimore, MD, October 24, 1977.

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